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MULTILATERAL INVESTMENT GUARANTEE AGENCY
M.I.G.A.

Beyond Bonn

World Bank Group Progress on Renewable Energy and Energy Efficiency in Fiscal 2005–2009

BEYOND BONN:

World Bank Group Progress on Renewable Energy and Energy Efficiency in Fiscal 2005–2009

World Bank Group

Energy and Mining Sector Board

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Acronyms and Abbreviations

ACORE	American Council on Renewable Energy
AFR	Sub-Saharan Africa Region
AFREA	Africa Renewable Energy Access Grants Program
AFTEG	Africa Energy Unit
ASTAE	Asia Sustainable and Alternative Energy Program
CEEP	India Chiller Energy Efficiency Project
CFB-IBRD	Carbon Finance Business
CFC	Chlorofluorocarbon
CFL	Compact fluorescent lamp
CIF	Climate Investment Funds
CPF	Carbon Partnership Facility
DFID	U.K. Department for International Development
DSM	Demand-side management
EAP	East Asia and Pacific Region
EBRD	European Bank for Reconstruction and Development
ECA	Europe and Central Asia Region
EE	Energy efficiency
EECI	Energy Efficient Cities Initiative (ESMAP)
EF	Environmental Flows (policy)
ELI	Efficient Lighting Initiative
ESCO	Energy service company
ESKOM	South African electricity public utility
ESMAP	Energy Sector Management Assistance Program
FEMA	Forum of Energy Ministers of Africa
FY	Fiscal year
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas
IBRD	International Bank for Reconstruction and Development
ICLEI	Local Governments for Sustainability (international association of local governments for sustainable development)
IDA	International Development Association
IDBI	Industrial Development Bank of India
IDCOL	Infrastructure Development Company Ltd., Bangladesh
IEA	International Energy Agency
IFC	International Finance Corporation
INFRA	Infrastructure Recovery and Assets
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
LCR	Latin America and Caribbean Region
LED	Light-emitting diode
LHWP	Lesotho Highlands Water Project
MFI	Microfinance institution
MIGA	Multilateral Investment Guarantee Agency
MLF	Montreal Protocol's Multilateral Fund
MNA	Middle East and North Africa Region
NGO	Nongovernmental organization
OECD	Organisation for Economic Co-operation and Development
PPIAF	Public Private Infrastructure Advisory Facility
PV	Photovoltaic(s)

RE	Renewable energy
REEEP	Renewable Energy and Energy Efficiency partnership
REN21	Renewable Energy Policy Network for the 21st Century
RERED	Rural Electrification and Renewable Energy Development Project
RPS	Renewable energy portfolio standard
SADC	Southern African Development Community
SAR	South Asia Region
SCF	Strategic Climate Funds
SEFI	Sustainable Energy Finance Initiative (UNEP)
SFDCC	Strategic Framework for Development and Climate Change
SHS	Solar home system
SREP	Scaling Up Renewable Energy in Low-Income Countries
TDE	Bolivia Transportadora de Electricidad SA
U.K.	United Kingdom
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Units of Measure

GW	Gigawatt
MW	Megawatt
ppm	Parts per million
TWh	Terawatt-hour
Wp	Watts peak

Foreword

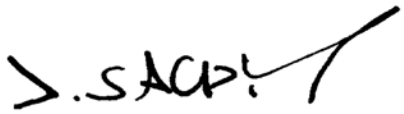
Over the past five years, it has become increasingly clear that renewable energy and energy efficiency offer sustainable solutions to problems of energy access, climate change, and fuel price volatility. The increasing penetration of renewable energy sources in the primary energy mix of a wide variety of low-, middle-, and high-income countries demonstrates the overall desirability of low-carbon energy sources and their economic and financial viability, paving the way for them to play an even greater role in the near future.

The World Bank Group is proud to have helped lead the shift towards low-carbon economies around the world through its partnerships with client countries. The World Bank Group is pleased to report that its cumulative new renewable energy and energy efficiency financing in fiscal 2005–09 reached almost US$7 billion. In these five years, the World Bank Group's financing for renewable energy and energy efficiency expanded to 364 projects in 85 countries, many of which implemented their first alternative energy projects ever. Just in fiscal 2009, the new renewable energy and energy efficiency investments reached US$3.1 billion, a historic high.

This report is the fifth in the series documenting the World Bank Group's progress in supporting renewable energy and energy efficiency. It details the successes of, and lessons learned from, the investments made by the World Bank Group over the past five years. The case studies provide specific examples of financial and technical innovations that the World Bank Group has employed for financing of energy efficiency and renewable energy projects. The World Bank Group will continue to leverage the tools at its disposal—including new financing instruments and technical and policy assistance—to aid low- and middle-income countries in harnessing renewable energy resources and benefiting from energy efficiency improvements.

We thank our partner countries, other bilateral development partners and the World Bank Group staff for their hard work in this area, and especially for their highly valuable contributions and steadfast dedication to promoting the use of renewable energy and energy efficiency around the world.

Greg Radford, Director
Environment and
Social Development Department
International Finance Corporation



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Executive Summary

The World Bank Group puts renewable energy and energy efficiency at the heart of its energy agenda. Millions of people around the world—including some of the poorest—have gained a better quality of life through World Bank Group investments in solar, wind, hydro, geothermal, biomass, biogas, and energy efficiency projects.

A Significant Success

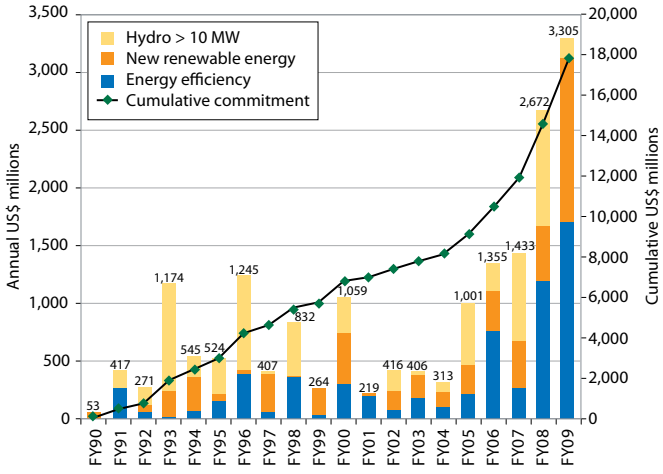
In 2009 World Bank Group financing of renewable energy and energy efficiency projects and programs in developing countries increased 24 percent to reach US$3.3 billion, the highest ever. The World Bank Group achievement for fiscal 2009 is particularly significant, because it occurred in the midst of the global financial crisis and a dip in oil prices that the International Energy Agency (IEA) estimates will contribute to a 38 percent decline in global renewable energy investments. Commitments since July 2004 were US$9.8 billion, compared to US$2.5 billion the previous five years. Table 1 shows World Bank Group lending on renewable energy and energy efficiency in fiscal 2005–09.

Since 2000, the World Bank Group has committed more than US$12.1 billion to renewable energy and energy efficiency (Figure 1). During the past 5 years, the World Bank Group approved 364 renewable energy and energy efficiency projects in 85 countries (Figure 2). There were 99 projects in 46 countries last year alone. Building on the record-high financing of the past fiscal year, the World Bank Group is expanding support for renewable energy and energy efficiency. Today the renewable energy and energy efficiency agenda is deeply rooted in the World Bank Group's operations around the globe.

> *"Five years ago, we thought we were stretching ourselves by promising to expand support for renewable energy and energy efficiency by 20% per year. As it turns out, our client countries have been even more ambitious in asking us to help them in this area, and we've been able to respond with robust investments to help build the low-carbon economies each country is seeking. We've now committed to even more challenging goals on clean energy and carbon intensity reduction investments as we strive to make reliable energy access for all a reality."*
>
> —Katherine Sierra
> Vice President, Sustainable Development
> The World Bank

The World Bank Group share of commitments for renewable energy and energy efficiency has risen steadily relative to total energy commitments. It rose to 36 percent in the past five years compared to 13–20 percent in the years preceding (Figure 3).

Figure 1: World Bank Group Commitments for Renewable Energy and Energy Efficiency, 1990–2009



Source: World Bank Group data.

Table 1: Renewable Energy and Energy Efficiency Commitments by Institution
(millions of U.S. dollars)

	FY 2005–09			
	EE	*Hydro > 10 MW*	*New RE*[1]	*Total*
World Bank	**2,689**	**1,635**	**1,872**	**6,197**
IBRD/IDA	2,418	1,199	1,364	4,981
GEF	186	0	321	508
Carbon Finance	82	118	178	378
Others[2]	3	318	9	330
IFC	**1,404**	**862**	**948**	**3,214**
Own funds	1,404	862	873	3,139
GEF	0	0	5	5
Carbon Finance	0	0	69	69
MIGA	**40**	**227**	**90**	**357**
Total	**4,133**	**2,724**	**2,910**	**9,767**

	FY 2009			
	EE	*Hydro > 10 MW*	*New RE*[1]	*Total*
World Bank	**1386**	**43**	**840**	**2,269**
IBRD/IDA	1,311	43	804	2,157
GEF	68	0	15	83
Carbon Finance	8	0	21	29
Others[2]	0	0	0	0
IFC	**315**	**135**	**587**	**1,036**
Own funds	315	135	587	1,036
Total	**1,701**	**177**	**1,427**	**3,305**

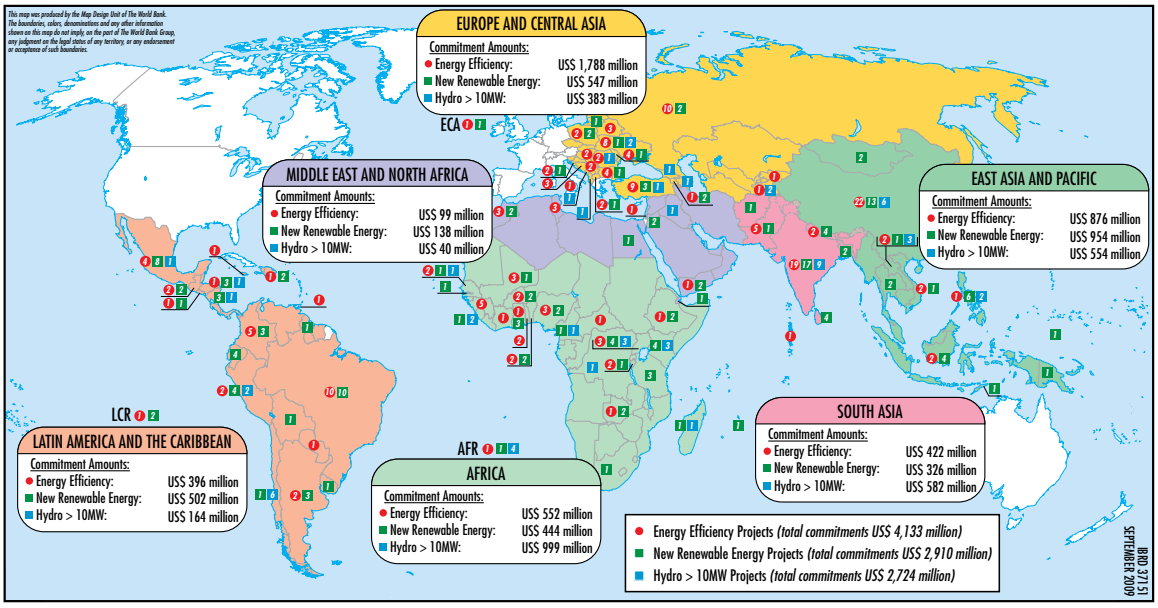
1. New RE comprises solar, wind, biomass, and geothermal, as well as hydropower with capacities up to 10 MW per facility.
2. Includes Guarantees, Recipient Executed, and Special Financing; US$100 million in Clean Technology Fund funding for Turkey is not included.

In FY 2009, renewable energy and energy efficiency commitments exceeded 40 percent of total energy lending commitments.

The Bonn Commitment Exceeded

At the Bonn International Conference on Renewable Energies in 2004, the World Bank Group committed itself to increasing its lending for new renewable energy (all forms of renewable energy, including hydropower up to 10 MW per facility) and energy efficiency in fiscal 2005–09 by an average of 20 percent each year over the baseline of US$209 million. The investments during this period exceeded the Bonn commitment by 277 percent, reaching more than US$7 billion, compared to an expected commitment of US$1.9 billion (Table 2).

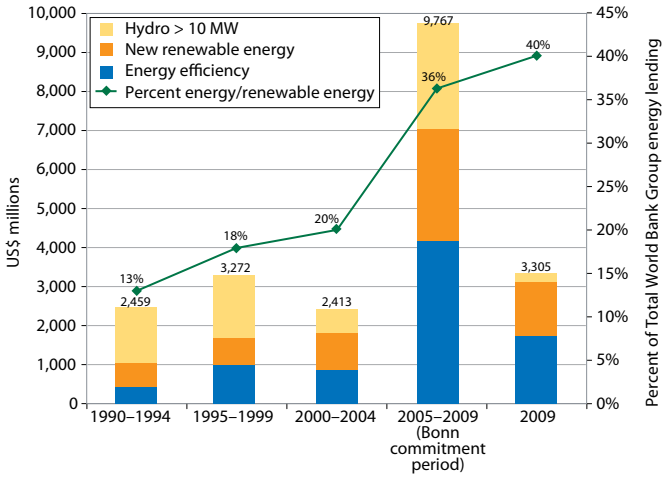
Figure 2: World Map with Distribution of Renewable Energy and Energy Efficiency Projects, Fiscal 2005–09



Factors Contributing to the Expansion of Renewable Energy and Energy Efficiency Investments

During the past five years, the World Bank Group, with support from its development partners, worked intensively with its client countries to identify opportunities for renewable energy and energy efficiency and to incorporate such investments into Country Assistance Strategies. The World Bank Group supported energy sector reforms, built capacities, funded project preparation, introduced new private sector business models that were better suited for renewable energy and energy efficiency, and provided considerable financing. During the same period, energy and climate change steadily became issues of central importance on the international stage, as well as in the domestic policy dialogues of most countries. Thorough analyses and consequent warnings from the scientific community have increased awareness of climate change and emphasized the urgency of adopting mitigation strategies to maintain atmospheric concentrations of greenhouse gases (GHGs) within desirable limits.

Figure 3: Share of World Bank Group Commitments for Renewable Energy and Energy Efficiency Relative to Total Energy Sector Commitments



Source: World Bank Group data.

Coupled with these developments were major policy changes in industrial countries, such as

Table 2: Measuring Progress in Energy Efficiency and New Renewable Energy Lending against Bonn Commitment Targets
(millions of U.S. dollars)

	Average	*Bonn commitment period*					
	FY02–04	*FY05*	*FY06*	*FY07*	*FY08*	*FY09*	*FY05–09*
Actual new RE and EE	**209**	463	1,105	682	1,665	3,128	**7,043**
Bonn commitment target		251	301	361	433	520	**1,866**
Hydro > 10 MW (not in Bonn commitment)		538	250	751	1,007	177	**2,724**

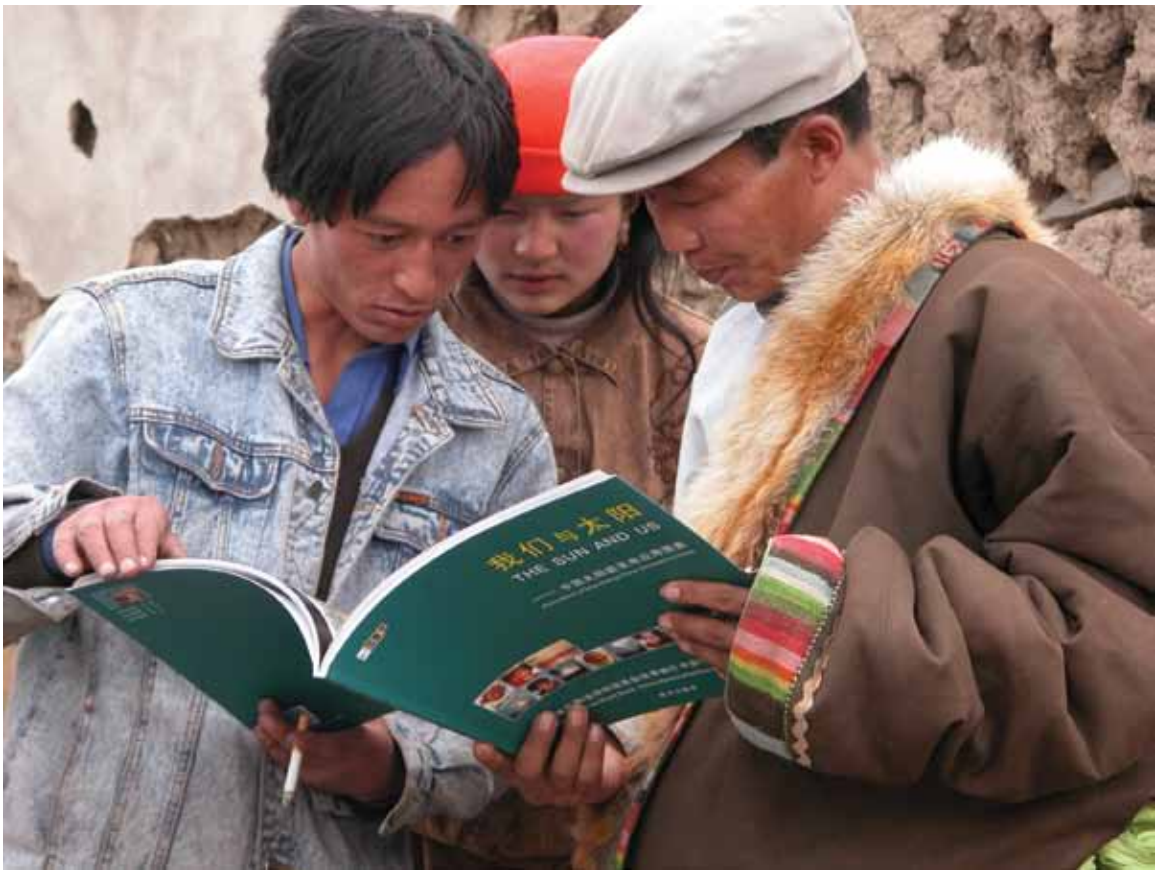
the introduction of renewable portfolio standards, feed-in tariffs, and other incentives and financing to promote renewable energy and energy efficiency. The resulting large investments in industrial countries led to economies of scale in production and a reduction in costs (although some short-term supply bottlenecks did increase the prices of some components). These projects also had an important demonstrative and confidence-building effect in developing countries, creating a better understanding of conditions for deployment and improved operational management. Some of the largest developing countries, notably China and India, implemented targets and policies to promote clean energy. Globally, investments in renewable energy reached US$120 billion in 2008, from around US$24 billion in 2004, a fivefold increase. In the same period, World Bank Group support for renewable energy increased almost sevenfold, from US$221 million in fiscal 2004 to US$1,480 million in fiscal 2008. Oil price rises to US$147 per barrel, and gas and coal price increases, together with increased price volatility, gave further impetus to considering energy alternatives and improvements in energy efficiency. The private sector and private equity firms have shown a greater appetite for investments in alternative energy, proving to be a harbinger of a low-carbon growth path for the World Bank Group's partner countries.

Rural and urban communities, small and large industries, public and private institutions and, most importantly, people have benefited from the myriad of renewable energy and energy efficiency projects supported by the World Bank Group. While the projects have increased access to electricity, reduced energy consumption and peak loads, and improved fuelwood supplies, they have enhanced the economic condition of people, increased productivity, and reduced indoor pollution and global carbon emissions. The projects have increased the ability of public institutions to enable markets and enhanced the ability of domestic financial institutions and industries to deliver renewable energy and energy efficiency products and services.

Lessons Learned

A number of general lessons have emerged from the World Bank Group's experiences. Some may seem self-evident, but they are too frequently overlooked:

- Money alone will not bring change. Efforts need to be focused on capacity building, establishment of sound policy frameworks, and good governance. That being said, without financial resources, broader deployment of renewable energy and energy efficiency will not happen. Moreover, synchronization



Chinese villagers, whose village in Qinghai Province uses solar energy, reviewing solar electricity experiences.

between investments and capacity building is needed. If timely investments do not occur, the capacities already built will quickly dissipate.

- Governments must be market enablers, and they must create a favorable business and regulatory environment, and adopt transparent decision-making mechanisms. Energy sector reform is essential if investments are to pay off and be scalable and sustainable, and if the benefits are to flow to those most in need.
- The vast majority of projects supported by the World Bank Group have been owned and implemented by the private sector. This is a testament to the importance of the private sector in renewable energy and energy efficiency development. Therefore, it is necessary to engage with private sector interests, including project developers, technology suppliers, and entrepreneurs, to obtain their perspectives on market needs. What works in one country at one time may not be what is needed elsewhere or at another time.
- Given the immense challenges at hand, increased coordination at both the local and global levels and among multilateral and bilateral agencies, governments, nongovernmental organizations (NGOs), the private sector, and community groups is imperative to avoid duplication of projects and programs.
- Ensuring financial and economic viability is of paramount importance, or projects will not

be sustainable over the long term. Donors and governments should be cautious about introducing heavily subsidized programs. These efforts may provide a small short-term boost, but may not support the long-term development of nascent commercial markets. They can often hinder entrepreneurs in developing countries from delivering alternative energy products and services in a profitable and sustainable manner.

- Capital investments must be linked closely to committing resources and building capacities to maintain facilities and provide reliable and useful services over the long term. Too often, provision of maintenance and repair is overlooked or the challenge underestimated.
- Innovation in technology, business model and financing is necessary. Given the enormity of the challenge and the huge resources needed, it is necessary to find low-cost ways of sustainably providing these energy services and more rapid ways of building the infrastructure and human capacity and introducing the technology.
- Finally, and most importantly, sustained commitment to action by all partners is needed. Good intentions alone are insufficient.

Looking Ahead

Much of the world has yet to realize the full potential and transformative promise of renewable energy and energy efficiency. At the global level, energy-related GHG emissions account for about 70 percent of total emissions and are projected to grow by about 50 percent by 2030 unless supportive and effective policy measures are introduced very soon. Time is not on our side; delay adds to the challenge and makes meeting any given goal more difficult. Meeting developmental goals while stabilizing GHG emissions will require massive investments in renewable energy and energy efficiency. To reduce the financing resource gap in addressing the challenge of scaling up renewable energy and energy efficiency, World Bank Group funds will have to be complemented by new concessional resources, in addition to the Global Environment Facility (GEF) and carbon market finance.

One such resource is the US$6.2 billion Climate Investment Funds (CIF), a new source of financing for pilot projects to initiate transformational change toward low-carbon and climate-resilient development in the largest GHG-emitting developing nations. As part of the CIF, the US$5.1 billion Clean Technology Fund (CTF) promotes investments in clean technologies to allow developing countries to grow on a low-carbon path. The very first CTF project was approved in May 2009, with US$100 million of additional financing supporting the US$500 million lent by the World Bank Group to encourage private sector renewable energy and energy efficiency investments in Turkey.

Another part of the CIF—the Strategic Climate Funds (SCF)—provides financing to pilot new approaches that have potential for scaled-up, transformational application targeting specific climate change challenges or sectoral responses. For example, a program for Scaling Up Renewable Energy in Low-Income Countries (SREP), will demonstrate the economic, social, and environmental viability of low-carbon development pathways by creating new economic opportunities and increasing energy access through the use of renewable energy. Initially to be capitalized at US$250 million, the SREP will be piloted in 5–10 low-income countries.

The establishment of two new carbon facilities in the World Bank—the Carbon Partnership Facility and the Forest Carbon Partnership Facility—marks a new phase for the World Bank's carbon finance business. The move reflects the World Bank's growing focus on scaling up climate change mitigation work and deepening and

broadening the carbon market beyond the current 11 carbon funds and facilities, which have a total capital value of more than US$2 billion. Acknowledging that infrastructure investments and maintenance were the main casualties during and after the Asian financial crisis of the late 1990s and other similar economic contractions, the World Bank Group has launched the Infrastructure Recovery and Assets (INFRA) platform to prevent such an outcome after the current recession.

During the past two years, the World Bank Group launched several initiatives to build on its record of growth and provide expanded support for renewable energy and energy efficiency. The 2008 board-approved paper, *Development and Climate Change: A Strategic Framework for the World Bank Group* (SFDCC), serves to guide and support the operational response of the World Bank Group to new development challenges posed by global climate change. The SFDCC commits to a more ambitious target than the Bonn commitment to increase the share of low-carbon projects (new renewable energy, energy efficiency, and hydropower) to 50 percent of total energy lending in fiscal 2011 by undertaking the following:

- Increasing financing for energy efficiency and new renewable energy by an average of 30 percent a year, from a baseline of US$600 million.
- Expanding lending to hydropower that meets environmental and social safeguards and is economically and financially viable.

The World Bank's Energy Strategy (under preparation) will provide a framework to achieve the twin objectives of (a) improving access to and reliability of energy supply, and (b) facilitating the shift to a more environmentally sustainable energy development path. This strategy will be informed by extensive global consultations with all stakeholders, will promote complementary roles of the public and private sectors, will facilitate the use of innovative financial products and technical assistance, and will provide renewed attention to incentives for energy efficiency and renewable energy, as well as to subsidy and pricing issues.

Going forward, the World Bank Group will continue to leverage its technical expertise, policy advice, and financing resources to further catalyze and mainstream renewable energy and

Construction of the 156 MW St. Nikola Wind Farm in the municipality of Kavarna, in the north-east of Bulgaria, on an elevated plain approximately 3km from the Black Sea (IFC project, "AES Kavarna"). The wind park comprises 52 3 MW V90 turbines, manufactured by Vestas A.S. (Vestas) of Denmark. The project includes a 33/110 kV substation, connected to the national grid through an 8 km transmission line.

energy efficiency applications by the public and private sectors in its client countries. Global energy, environmental, and development challenges demand no less.

Chapter 1: Introduction and Global Context

Renewable energy (RE) and energy efficiency (EE) adoption has seen a remarkable surge over the past five years. Excluding large hydropower, renewable energy sources have contributed 120 GW of the new capacity installed around the world, rising from 160 GW in 2004 to 280 GW in 2008.[1] Various factors have accelerated deployment of these alternatives to conventional thermal energy generation, including growing recognition of the urgent need to mitigate climate change (and subsequent national and international policy drivers), energy security concerns, a rapid decrease in the associated costs of such technology, broader commercial availability, and volatility in the prices of fossil fuels. The World Bank Group has led and facilitated progress in this sector with a variety of tools, including financing, technical assistance, and regulatory advice. This chapter will examine these various drivers and their impacts on the trends in deployment of clean energy over the past five years.

This report contains four chapters. Chapter 2 will examine the lessons learned from the implementation of renewable energy and energy efficiency investments by the institutions of the World Bank Group. Chapter 3 will examine the renewable energy and energy efficiency portfolio of the World Bank Group and ascertain the dominant trends in project types, regions and sectors, and achievements in analytical and advisory activities. The concluding chapter will examine the way forward.

Trends

Additions to renewable energy capacity have been occurring across developed and developing countries, especially in the latter. About 43 percent of total global renewable capacity is now in developing countries, including large hydropower. Global renewable power capacity is estimated to be 1,140 GW.[2] In 2008, for the first time, more investments were made in renewable than in conventional power capacity.[3] The capacity added from renewable sources reached a record 25 percent of total generation capacity additions in 2008.[4]

The growth of investments in global renewable energy assets survived the economic crisis of 2008, increasing 13 percent from US$103 billion in 2007 to US$117 billion in 2008. Wind and solar accounted for US$85.3 billion, reflecting the increasing maturity and acceptance of these energy sources.

In 2008, US$36 billion was invested in sustainable energy in developing countries, of which US$15.6 billion was in China, US$10.8 billion in Brazil, and US$3.2 billion in India. The share of sustainable energy generated in developing countries has consistently increased, reaching 31 percent of the total global investment volume in 2008.[5] China now represents 27 percent of the global renewable power capacity (excluding hydropower) with 76 GW installed as of 2008, a significant share of which is in off-grid applications. China has led the developing world in wind and hydropower investments, becoming the largest market for such projects.

[1] REN21, *Renewables Global Status Report: 2009 Update* (Paris: REN21 Secretariat, 2009).
[2] Ibid.
[3] Ibid.
[4] UNEP-SEFI-New Energy Finance, *Global Trends in Sustainable Energy Investment 2009* (New York: UNEP, 2009).
[5] Ibid.

These investments have also attracted private manufacturers of energy equipment in large numbers. At the end of 2008, there were estimated to be about 70 major wind turbine manufacturers globally and over 450 photovoltaic (PV) module makers, many of which are in China, India, and other developing countries.[6]

The investments have been diverse in source, with venture capital and private equity playing an increasingly greater role. Just in 2008, venture capital and private equity funds invested more than US$19 billion in renewable energy and energy efficiency firms—up 43 percent over just the previous year. Wind and solar sectors dominated in the funding generated from private capital. However, this level of investment may decline at least temporarily in the near term, given the recent turmoil experienced by financial markets. This rapid growth has been driven by several factors, most notably climate change concerns, energy security goals, and new financial incentives.

Climate Change Policy Drivers

Over the past five years, energy and climate change have steadily become issues of central importance on the international stage, as well as in the domestic policy dialogues of most countries. Thorough analyses and consequent warnings from the scientific community have increased awareness of climate change and emphasized the urgency of adopting mitigation strategies to maintain atmospheric concentrations of GHGs within desirable limits.

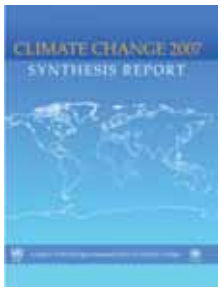
In 2007, the Fourth Assessment Report[7] of the Intergovernmental Panel on Climate Change (IPCC) concluded that

- Evidence of anthropogenically induced climate change is "*unequivocal*."
- "…with current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades."[8]
- "Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century."
- The impacts of climate change would be diverse and varied in intensity, frequency, and geographic distribution, and could be abrupt and potentially irreversible for centuries.

To prevent such large increases in emissions, very large investments will be needed in the energy sectors of the largest GHG-emitting countries.

The Stern Review, *The Economics of Climate Change*, sponsored by the U.K. government, also presents an economic case for mitigation.[9] The review warns that "[c]limate change threatens the basic elements of life for people around the world—access to water, food production, health, and use of land and the environment."[10] It further states that "the benefits of strong, early action considerably outweigh the costs," and that "evidence shows that ignoring climate change will eventually damage economic growth." The report highlights the role that renewable energy options can play in moving to a sustainable growth path, noting that "stabilisation of greenhouse-gas concentrations in the atmosphere is feasible and consistent with continued growth." The role of energy efficiency in mitigation is

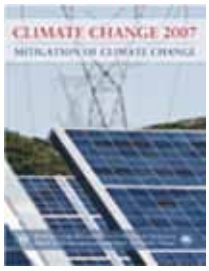
[6] Ibid.
[7] IPCC, *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva: IPCC, 2007).
[8] Ibid.
[9] Nicholas Stern, *The Economics of Climate Change: The Stern Review (Cambridge, U.K.: Cambridge University Press,* 2007).
[10] Ibid.



Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report.

The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report.

Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report.



Mitigation. Contribution of Working Group III to the Fourth Assessment Report.

These 2007 Intergovernmental Panel on Climate Change reports can be found at: http://www.ipcc.ch.

similarly emphasized in the International Energy Agency's Energy Technology Perspectives, which emphasizes that "[f]or all mitigation scenarios, energy efficiency improvements in buildings, appliances, transport, industry and power generation represent the largest and least costly savings."[11]

With the scientific background provided by the Fourth Assessment Report,[12] the International Energy Agency's World Energy Outlook 2008[13] estimates that to keep carbon dioxide levels at 550 ppm by 2030, an *additional* investment of US$1.2 trillion would be required in the global power sector between 2010 and 2030, as well as US$3 trillion in energy efficiency over the baseline requirement of US$6.1 trillion. Close to a third of the additional investment, US$400 billion, would be required in developing countries. Depending on assumptions about discount rates, these huge investment needs would be largely or entirely offset by the corresponding fuel savings, which are estimated to be on the order of US$7 trillion during the period 2010–30.

Other studies in recent years have reinforced these conclusions.

Role of the World Bank Group

At the Bonn International Renewable Energies Conference, the World Bank Group committed to scaling up its support for renewable energy

[11] IEA, *Energy Technology Perspectives 2008: Scenarios & Strategies to 2050* (Paris: IEA, 2008).
[12] IPCC, *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Geneva: IPCC, 2007).
[13] IEA, *World Energy Outlook 2008* (Paris: IEA, 2008).

and energy efficiency (see Box 1) as a means of advancing sustainable development in developing countries. There has been growing recognition that countries must accelerate clean energy deployment in order to address climate change. A 2005 communiqué issued by the G8 at Gleneagles explicitly stated that such efforts must include developing states. Also at Gleneagles,

Parabolic trough reflectors for the WBG/GEF-financed Al-Kureimat solar thermal power plant in Egypt being assembled, March 2009.

Box 1: World Bank Group Bonn Commitment

1. The World Bank Group's strategy—through programs and policies—will aim to ensure that renewable energy and energy efficiency are seen as economically viable and essential ingredients in the energy choices of our member nations, not marginal considerations.
2. With the aim of ensuring an institutional focus on the transition toward cleaner energy sources, the World Bank Group will commit to a target of at least 20 percent average growth annually—in both energy efficiency and new renewable energy commitments—over the next five years (FY2005–09).
3. The World Bank Group will lead a study to develop the concept of a Renewable Energy and Efficiency Financing and Policy Network that will address the issues of developing countries.
4. To foster greater collaboration across national and institutional lines, the World Bank Group will commit to reporting its annual performance in renewable and energy efficiency programs.
5. The World Bank Group will aim to provide sector-specific information to better engage a wide range of stakeholders on trends regarding specific technologies, including hydroelectric, wind, solar, geothermal, and biomass.
6. The World Bank Group will increase not only its staff capacity, but also the resources at its disposal and the incentives within its programs, so that the it can more effectively help country and sector teams succeed in implementing renewable energy and energy efficiency projects, as well as transfer best practices across sectors and regions more rapidly.

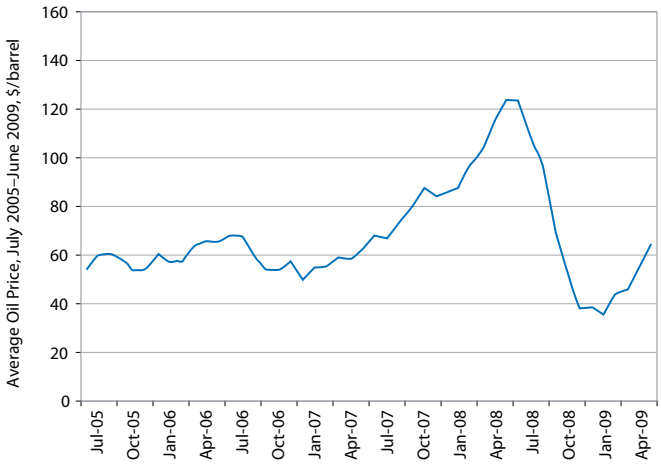
the World Bank Group was tasked with preparing a Clean Energy Investment Framework to allow the large emerging nations to adopt low-carbon growth plans. Consequently, at the UNFCCC Conference of Parties meeting in Bali in December 2007, the World Bank Group led discussions on financing climate change mitigation and adaptation. These discussions have continued in subsequent "Bali Breakfasts" at the Spring and Annual Meetings of the World Bank at the highest levels of government. These multinational events were supplemented by various parallel bilateral efforts, including the U.S.-China Strategic and Economic Dialogue and the Indo-U.S. civilian nuclear agreement, both of which included climate change mitigation as a main goal. These events, declarations, and efforts brought about a greater global understanding of climate change mitigation as an international issue in need of immediate global attention. New renewable energy and higher energy efficiency will play a crucial role in this effort, supported by various financing mechanisms.

Alternative Energy and Energy Security Implications

Apart from their contributions to climate change mitigation, renewable energy and energy efficiency projects help diversify country energy supplies. By reducing the need for fossil fuels, renewable energy sources allow countries to limit their exposure to volatile international energy prices. Between July 2005 and June 2009, this volatility accelerated the need for net importing countries to diversify their primary energy mix (see Figure 4).

World oil prices experienced markedly sharp volatility in the middle of 2008, reaching all-time highs of about US$140 per barrel. Internationally traded coal has also seen price volatility, along with shortages in some countries. The run-up to this price spike had an adverse influence on

Figure 4: World Oil Prices, Monthly Averages, July 2005 to June 2009
(US$/barrel)



Source: World Bank Group data.

an already-worsening global food crisis, compounding the impact on the poor. The volatility in oil prices and increasingly higher dependence on imported sources of energy—even fuels like coal that have traditionally been domestically produced—have made it evident that harnessing alternative energy sources is imperative for development.

Renewable Energy and Energy Efficiency Incentives and Experience

In the past five years, a growing number of countries have enacted renewable energy programs to provide incentives for accelerated deployment. These incentives vary across jurisdictions, ranging from feed-in tariffs, production tax credits, and cost subsidies to portfolio standards. European countries have provided large renewable energy subsidies that have enabled a rapid scale-up in sales and brought global price reductions. For example, Spain has provided incentives for solar power in the amount of € 0.23–0.44/kWh, which led to the commissioning of 640 MW of solar power in 2007. Another 55 MW of con-

centrating solar power was commissioned in 2008, and three more plants are expected to come online in 2009.[14] Spain is now the fastest-growing market for solar power technologies. Just in 2008, 2.6 GW of new solar capacity was installed in the country, a fivefold increase over the 550 MW installed in 2007.[15] Various other European countries, as well as Japan and the United States, have also enacted renewable energy incentives, varying by fuel, technology, and mode of delivery.

With such large increases and cost reductions, newer applications, such as building-integrated PV and advanced thin-film cells, are being used, complementing the PV market for off-grid electrification (see Case Study 2). As prices continue to decrease in 2009 and 2010, it is expected that PV will play an even greater role in the energy mixes of developing and developed countries.[16] There are already reports of module prices falling below traditional price barriers of US$1 per watt because of higher unused capacities, as well as higher production volumes and new technologies.

Renewable energy and energy efficiency incentives are not limited to developed countries. India was among the first countries to offer feed-in tariffs for renewable energy, and it has maintained that approach for newer technologies over the last few years. India and Thailand were among the first countries to provide incentives for energy efficiency. In China, incentives for mini-hydropower have helped make the country the leader in installed capacity for this energy source.[17] The World Bank Group has been consistently involved with energy efficiency interventions in both India and China, which has helped bring about a transformative change. Energy efficiency incentives can take various forms in different situations, as seen in the International Finance Corporation's (IFC's) Efficient Lighting Initiative (see Case Study 1). This effort provided an impetus for high-quality efficient lighting to overcome issues of scale. Such lighting technology is now widely used around the world.

Developed and developing countries' policy-driven incentives have created market demand, which has led to greater private investments in manufacturing. Correspondingly, the number of publicly traded renewable energy companies increased from about 60 in 2005 to 160 in 2008.[18] The energy equipment sector saw a rapid price increase between 2005 and 2007, which also affected renewable energy and energy efficiency prices. However, recent statistics and developments show that the renewable energy and energy efficiency sector has maintained its growth, while the prices of conventional power systems were markedly volatile over the past year. Private equity and investments in the alternative energy sector have been encouraged by policy changes and incentives targeting development of renewable energy and energy efficiency. Renewable energy and energy efficiency was one of the few areas to experience growth despite the economic slowdown of 2008, and investments in the sector's firms grew 43 percent over 2007 figures in 2008, reaching a total of US$19.3 billion.

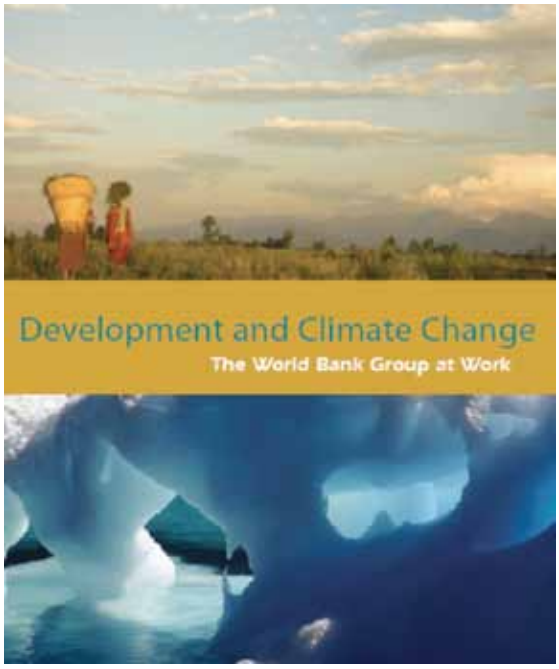
World Bank Group Interventions and Initiatives—Beyond Bonn

Building on experiences gained and successes achieved, the World Bank Group is now moving beyond the Bonn commitment. In September 2008, the World Bank Group laid out its approach to sustainable growth in a climate-constrained world in *Development and Climate Change: A Strategic Framework (SFDCC)*. The

[14] REN21, op cit.
[15] Ibid.
[16] "Land of the Rising Subsidy" (*The Economist*, August 27, 2009).
[17] REN21, op cit.
[18] Ibid.

framework commits the World Bank Group to having 50 percent of total energy lending for low-carbon investments by fiscal 2011, and also commits to increasing its support for new renewable energy and energy efficiency by 30 percent per year from a baseline of US$600 million, while continuing to support efforts in environmentally and socially sustainable hydropower. The SFDCC calls for additional financing to assist developing countries in meeting their mitigation goals. Some of the additional required financing will be provided through the Climate Investment Funds (CIF), established in 2008.

CIF comprises various targeted funds, two of which are dedicated to energy investments. The Clean Technology Fund (CTF) focuses on transformative low-carbon energy investments in middle-income countries while the proposed Scaling Up Renewable Energy Program (SREP) aims to provide access to modern energy services in low-income countries using renewable sources. These funds are intended to support innovative projects that transform markets in ways that can be replicated in other countries, so as to help developing countries grow on a low-carbon path. The World Bank Group continues to look for innovative financing mechanisms to facilitate rapid growth in alternative energy investments.



http://beta.worldbank.org/climatechange/

Case Study 1

The IFC/GEF Efficient Lighting Initiative Transforming Markets for Energy-Efficient Lighting

What are the long-term impacts of sustainable energy market transformation projects? And what are the benefits of long-term engagement in a sector? Some insight into these questions can be gained from a current perspective on an IFC energy efficiency project completed several years ago, the Efficient Lighting Initiative (ELI). Implemented between 1999 and 2003, ELI has had lasting impacts on the World Bank Group, its client countries, and international suppliers of efficient lighting products.

ELI aimed to change consumer perception of compact fluorescent lamps (CFLs), increase market availability, and improve quality while reducing price. With US$15 million in grant funding from the GEF, ELI operated in seven countries with very different markets: Argentina, the Czech Republic, Hungary, Latvia, Peru, the Philippines, and South Africa. Thanks to prior experience with several programs that relied largely on subsidies for short-term market stimulus, the IFC had a good knowledge of the lighting market, relevant technologies, and the challenges to consumer acceptance that CFLs—more expensive, but also much more efficient—might face. Avoiding subsidies, the ELI program concentrated on sustainably transforming local markets for CFLs, which at the time were not well known or widely marketed to consumers, and were sometimes of poor quality.

In 2005, the IFC and GEF contracted with the China Standard Certification Center (CSC) to expand the program beyond the initial seven countries and increase manufacturer participation.[1] The new ELI Quality Certification Institute is managed by the CSC and staffed with international experts from Asia and North and South America. The institute works with government agencies, international organizations, manufacturers, and other stakeholders to accelerate the adoption of energy-efficient lighting. Products from local companies like Anhui Electron and international manufacturers GE, OSRAM, and Philips are certified by the institute to meet high performance and technical standards that are used as criteria for procurement by energy service companies (ESCOs), national electricity utilities, and projects financed by the World Bank Group and similar institutions.

The program has been a success story, with both short-term and long-term impacts. An evaluation of the program's short-term impacts, undertaken at the close of ELI, showed that the program had indeed transformed markets. New distribution channels brought CFLs to people who previously had no access to them. Prices dropped, consumer awareness and understanding grew and, as a result, CFL sales increased. For example, in Peru, annual CFL sales in 2003 were nearly 20 times greater than before the program began.

ELI has also become a cornerstone of the World Bank Group's own procurement guidelines. ELI criteria and certification have been used to inform procurement for a number of large-scale CFL projects, totaling

[1] For more information about ELI, visit http://www.efficient-lighting.net/. 3 The Carbon Finance Assist program is implemented by the World Bank Institute (WBI).

some 50 million CFLs distributed in countries ranging from Argentina to Bangladesh, Mali to Mexico, and Rwanda to Vietnam. Cumulatively, the ELI-certified CFL distribution projects have had a significant impact on reducing GHG emissions.

In the longer term, the program's success is primarily a result of four factors of broad applicability**.** First, the results achieved during the program period helped build national awareness of the potential for energy and GHG reductions from energy-efficient lighting. Second, ELI created and/or built the capacities of institutions that have continued to be effective advocates of energy-efficient lighting beyond the conclusion of the program. Third, ELI developed and nurtured local staff who went on to become national champions for energy-efficient lighting. Finally, ELI developed an internationally accepted quality standard, allowing the effective aggregation of demand through the creation of a joint standard used by manufacturers and consumers of energy-efficient bulbs, as well as by financiers such as the World Bank Group.

Market research: Lima, Peru.

In South Africa, promotions were conducted in partnership with the Nelson Mandela Children's Fund.

Case Study 2:
Mainstreaming Solar Electrification in Bangladesh

At a Grameen Technology Centre in rural Bangladesh, young women sit around a table learning the parts of a solar home system (SHS). The young women are being trained to install and maintain SHSs, a skill that is in high demand these days in rural Bangladesh. Since 2002, 350,000 SHSs have been installed in Bangladesh, and 15,000 new systems are being installed every month. Fourteen SHS dealers operate across every region of the country. The success of the Bangladesh SHS development is rooted in the innovative design of the World Bank–financed Rural Electrification and Renewable Energy Development (RERED) Project. This project has been working with the existing institutions to enable the development of a market for SHSs. In so doing, the beneficiaries are not just the households that now have electricity from solar panels, but also the solar panel dealers, the parts manufacturers, the battery manufacturers, and the newly trained women technicians.

Solar energy for rural electrification was introduced to Bangladesh in 1997, but it was initially slow to take off. The RERED Project transformed the market through careful application of subsidies and financing, attention to quality, follow-up service, high technical standards, and good communication with customers. The financing scheme comprises a small output-based grant that amounts to only about 10 percent of the cost of the average-size panel (40 Wp), with the remaining cost of the system paid by the customers in monthly installments over three years. As of June 2009, the average collection efficiency of the dealers from the households was more than 98 percent. A number of factors contributed to the success of the scheme:

a. From the start of the project, there has been an active Technical Standards Committee that determines what components can be sold in the SHS packages, all of which must include warranties. This tight quality control has reduced the risk of product failures and raised consumer confidence in SHSs as an alternative electricity source.
b. The project leveraged the presence of a wide network of microfinance institutions (MFIs) in rural Bangladesh and the social acceptance of a microfinance mechanism by partnering with the MFIs to run the scheme. MFIs install the systems, extend microcredit to finance the systems, provide maintenance during the repayment period, and deliver training to the household members on operation and maintenance of the SHS.
c. The project also focused on consumer awareness, which reduced rural households' fear of this new technology, and helped consumers embrace it quickly. For the project to succeed, local adaptation was important. Given Bangladesh's conservative values, female technicians were trained and hired by the dealers so that customers could receive training in the house even if only women were home at the time of installation.

Not all of RERED's success can be attributed to the initial design. The project has adapted in many ways as new opportunities have become available, such as adding a carbon finance component to increase the financial returns from SHS sales. As with most elements of RERED, the success of the carbon financing relied heavily on the implementing agent, the Infrastructure Development Company Ltd. (IDCOL). Strong local capacity in IDCOL, as well as the MFIs that sell, finance, and service the SHSs, are what made RERED's success possible. As other countries try to replicate the success of RERED, it is important to note some of the lessons learned from this project:

a. **The importance of adapting to the local environment.** RERED was built on the framework of the MFI network, but that infrastructure does not exist everywhere. For new projects, it would be useful to look where the local capacity to deliver project requirements is strong and work within that framework.
b. **The importance of focusing on customer satisfaction.** In rural areas, experience with new technology spreads by word of mouth. Allowing poor-quality components into the market or failing to educate households on how to properly use SHSs could affect demand negatively.
c. **The importance of subsidizing just enough to incentivize, but not distort, the market.** A sustainable project should ideally help build the customer base to a level where economies of scale eliminate the need for subsidy.

The future of renewable energy in Bangladesh looks bright. In August 2009 the World Bank approved a further US$130 million in additional financing for RERED. The project will continue to primarily fund the SHS program of IDCOL, which has a total target of 1 million systems installed by 2012. The additional financing also includes funds for development of renewable energy minigrids—primarily biomass and biogas-based electricity generation and solar PV water pumping—and a program to replace incandescent light bulbs with energy-efficient CFLs. Bangladesh could also soon be reaping even wider economic benefits from its growing solar market, since local entrepreneurs have plans to start up local PV panel assembly plants. From these large industries down to the small rural shops that now stay open into the night, all of Bangladesh is enjoying the benefits of solar energy.

This entire rural market gets its electricity from SHS.

A rural household with SHS. The panel can be seen on the rooftop.

Chapter 2: Lessons from a Decade of IFC and World Bank Experience

This chapter focuses on the experiences and lessons learned from grid-tied renewable energy and energy efficiency projects of the World Bank Group, including work on new renewable technologies, large hydropower, and energy efficiency. During the past decade, the World Bank Group has implemented a large number of off-grid renewable energy projects benefiting more than 13 million people in about 30 countries (see Case Study 2, which describes a very successful off-grid electrification program in Bangladesh). Lessons learned from these projects were documented both in *Catalyzing Private Sector Investment for a Low-Carbon Economy: World Bank Group Progress on Renewable Energy and Energy Efficiency in Fiscal 2007*, and in Operational Guidance for World Bank Group Staff on *Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices*, issued in November 2008.

Grid-Tied Renewable Electricity

Both large- and small-scale successful grid-connected renewable energy projects have a number of common features, including the following:

1. Governments must be effective market enablers and not market makers, creating the policy and regulatory conditions for investment and risk-taking for a wide range of stakeholders without being overly prescriptive. Good governance leading to

Panabolon Health Center, Philippines; electrified under the World Bank/GEF-assisted Rural Power Project.

transparency in decision making and reductions in transaction cost and time is essential.
2. Access to long-term investment financing, as well as the introduction of risk mitigation and credit enhancement instruments, must be facilitated while minimizing moral hazard.
3. Availability of credible and long-term resource information on issues such as wind, hydrological, and geothermal resources is essential.
4. Good environmental, social, and institutional practices must be followed.

These are discussed in more detail in the following sections.

Lesson 1: Encourage governments to become "market enablers." In the experience of the World Bank Group, the majority of renewable energy projects have been implemented by the private sector—frequently the *domestic* private sector. To support and encourage further private sector investment in renewable energy, governments should facilitate market reform and development through the following actions:

- **Reduce or eliminate energy price distortions to create a level playing field**. Optimal levels of renewable energy will be deployed when conventional fuels and electricity are valued at their economic price devoid of subsidies. For example, based on an assessment of economic valuation of renewable energy vis-à-vis conventional power generation, China adopted a renewable portfolio standard mandating that 15 percent of total energy generation come from renewable sources by 2020. Similarly, avoided cost pricing for renewable energy electricity purchases from small renewable energy generators in Sri Lanka led to the private sector's adding nearly 150 MW of small hydropower in 10 years and providing about 4 percent of the total electricity generated.
- **Establish a transparent and stable framework and rules governing competition** to facilitate private sector involvement and investment in the power sector. Competitive wholesale markets with the active participation of private power producers have been important sources for investment in new renewable energy technologies, such as wind and small hydropower (large hydropower continues to be dominated by public utilities in developing countries). For an illustration of how such frameworks have enabled large-scale wind development, see Case Study 3.
- **Enact renewable energy portfolio standards (RPS's) or adopt other incentive mechanisms to overcome initial barriers and encourage early adoption.** Properly structured, these measures can invigorate the renewable energy and energy efficiency industry. An RPS requires that a minimum percentage of electricity sold in a given region or service territory be met by renewable energy sources. RPS proposals usually include power trading schemes whereby retail providers may trade their renewable energy generation obligations with one another in the form of "green certificates," so long as all meet their respective standards. Both China and India have national goals. China adopted an RPS that aims to increase the share of renewable energy in power generation to 15 percent of total generation by 2020; in India, the goal is 10 percent by 2012.[19] Another approach used in China, Germany, India, Kenya, and Spain is a feed-in tariff, which sets a fixed price for sales from defined renewable energy technologies. Typically, the feed-in tariff declines over time. Countries such as Sri Lanka and Tan-

[19] Eric Martinot, Akanksha Chaurey, Debra Lew, Jose Moreira, and Njeri Wamukonya, "Renewable Energy Markets in Developing Countries" (*Annual Review of Energy and the Environment* 27, 2002).

Power lines, Tajikistan.

zania use feed-in tariffs that are based on the avoided cost of generation.

- **Provide open access to transmission and reduce transmission bottlenecks.** An open-access transmission system is essential to allow the wheeling power between buyer and seller or to permit sellers to enter into a fair purchase agreement in the case of a single buyer. Transmission services should not discriminate against or give unfair advantage to specific types of ownership or generation. For example, open wheeling policies in India have been credited with catalyzing development of the wind industry. In this case, industrial firms may produce wind power in regions with good wind resources for use in their own facilities some distance away, or for sales to a third party.[20] The same approach is being used in Mexico. In Brazil, reduction of wheeling fees has been credited as a boon to investments in small hydropower. China has also proposed measures to reduce transmission bottlenecks that currently restrict development of wind resources far from population centers.
- **Reduce transaction costs** to improve project fundamentals from pre-investment to commissioning. These include the processes

[20] Ajit Gupta, "Policy Approaches: The India Experience," Proceedings of the International Conference on Accelerating Grid-Based Renewable Energy Power Generation for a Clean Environment, March 7–8 (Washington, D.C.: U.S. Energy Association, 2000).

Box 2: Taking a Cross-Sectoral Perspective in India—a River Basin Study

Planning the development of a state's river basin resources is generally the responsibility of the state government, with technical and regulatory oversight provided by the central government. When considering hydropower developments, the planning process typically focuses on individual projects rather than the entire river basin.

This approach has a number of drawbacks. First of all, failing to consider other infrastructure developments in the basin—which could augment the supply and thus change the price of electricity, or modify physical site conditions (for example, the level of silt in the water)—risks over- or underestimating the value of a power project. Furthermore, planners are likely to understand environmental and social impacts better—such as the cumulative impact of multiple projects on soil erosion—when projects are evaluated at the river basin level.

The River Basin Study currently under way will construct a framework for efficient hydroelectric power development at the river- basin level. Whereas the project-based approach fails to capture some costs and benefits of hydropower development, this study will target those factors in order to mitigate the risk faced by individual projects and enhance public-private partnerships.

involved in project development as well as standardization of contracts and procedures, increasing transparency in decision making, and minimization of bureaucracy. Both in winning approval of power purchase agreements and in establishing physical connections to the grid, bureaucratic bottlenecks have been cited as a significant hindrance to market development.[21] It is possible to reduce transaction costs through capacity building and knowledge dissemination among the domestic financial, industry, utility, and engineering sectors, as well as policy makers and consumers. Good governance is essential, especially for small power producers who rely on grid access assurance, standardized approaches that minimize transaction costs, and fair risk sharing.[22]

- **Build strong institutions and human capacities.** Strong institutions can develop and implement flexible, or "smart," systems that can anticipate and react to changing circumstances. A long-term, cross-sectoral perspective can help identify linkages between energy, water, climate change, and regional needs (see Box 2). Effective institutions and capable personnel will improve the prospects and strategic value of renewable energy power projects through the realization of effective planning and enabling policies, as well as regulatory frameworks. Coupled with the technical, engineering, business, and finance capabilities they sustain market growth. Strengthening the planning process requires a significant increase in funding and technical assistance for prefeasibility studies in order to develop a pipeline of high-quality projects.

Lesson 2: Increase access to long-term financing and risk and credit enhancement instruments while minimizing moral hazard.

All renewable energy technologies are capital-intensive but they also typically have low opera-

[21] Romesh Bandaranaike, "Local Developer Perspective on Market Scale-Up," Proceedings of the International Conference on Accelerating Grid-Based Renewable Energy Power Generation for a Clean Environment, March 7–8 (Washington, D.C.: U.S. Energy Association, 2000).
[22] Anil Cabraal and Steven Ferry, *ESMAP Knowledge Series: Power Purchase Agreements for Small Power Producers* (Washington, D.C.: World Bank, November 2006).

tion and maintenance costs. In order to be able to generate power at a competitive price, the high capital costs must be amortized over a sufficiently long period. Consequently, long-term debt is necessary.

In the current economic crisis, long-term maturity debt has become largely unavailable. This dramatic change has re-emphasized the critical importance of long-term debt-financing and other innovative financing mechanisms for renewable energy from the IFC, World Bank, and others.

Another way to address long-term financing is to look for innovative solutions, such as additional revenue from carbon financing. Although rarely feasible for initial project financing, carbon financing can provide an additional revenue stream over time if structured as performance-based annual payments. An example of such a project is the PCF Sugar Bagasse Cogeneration Project in Brazil. Other financial instruments, such as guarantees, are also effective in increasing access to long-term financing.

Lesson 3: Promote good environmental, social, and institutional practices.

All grid-connected power projects require sound social and environmental stewardship, especially hydropower development.

Environmental considerations: All large power projects have the potential to significantly impact their surrounding natural environments. This is especially true of hydropower schemes, which alter existing hydrological cycles and the dependent aquatic ecosystems. It is therefore critical that project developers create and abide by environmentally sound and adaptive management practices regarding field investigations, site selection, planning, design, mitigation, and monitoring. The most considerable environmental challenges are to adequately understand ecosystem components and functions, as well as environmental flows;[23] to minimize creation of new impacts through site selection and design, including incorporation of mitigation measures at the construction stage; and to monitor and respond to issues as they arise. The impact of hydropower schemes on the annual migration of significant fish species must be assessed; if disruption of migration routes is unavoidable, appropriately designed fish ladders or other mitigation strategies should be utilized to minimize fish mortality or injury. Protecting biodiversity and threatened species through habitat identification and conservation management is an important issue for consideration in environmental impact assessments, as well as during power scheme construction and management. Wind projects also sometimes adversely affect flyways and require roads for maintenance that may disturb animal habitats.

Give high priority to social considerations. Power projects can significantly reduce poverty and enhance the quality of life in the communities they serve. The challenge is to make sure that affected communities recognize the potential benefits that will accompany the changes inevitably brought by such projects. If community members understand the benefits of a project and participate in the planning and implementation processes, they will be more likely to support the project and appreciate the improvements in living conditions it might bring, such as the construction of public health facilities and other social compensation measures. Dam safety is another issue of concern with hydropower projects, especially protection from the consequences of dam failure. People who are likely to be displaced or otherwise affected by a new project should be adequately compensated, and their rights and needs must be addressed and negotiated during the development of the

[23] http://www.eflownet.org/

project. The World Bank Group's hydropower investments have shown the value of collaboration and communication in easing the way for large projects, as shown in Case Study 4.

Support an equitable distribution of economic benefits. Large grid-connected power projects should aim to provide an equitable distribution of benefits between government, project proponents, and stakeholders, such as traditional resource users. Opposition to large power projects is sometimes rooted in the perception that benefits flow disproportionately to project developers or other special interests. This is most often true of hydropower projects, despite their benefits, including longevity, favorable energy payback periods, and value in support of integrated energy systems. An equitable distribution of economic benefits between the groups mentioned above should be assured at all stages of project preparation, construction, and operation.

Create processes to engage and build partnerships with communities and other stakeholders. Early, frequent, and regular communication on the part of the government and project developers fosters cooperation and a sense of partnership between them and the affected communities (see Box 3). It is strategically intelligent to focus on transparency and communication, and to engage and consult stakeholders early in the project development cycle. Having stakeholder participation and approval can in turn strengthen financing options and further the global dialogue on sustainability. Project preparation and licensing provide opportunities for stakeholder capacity building. Improvements in the enabling environment include sound policies and institutions, effective regulatory oversight, attention to governance and corruption, and reliable off-takers. In hydropower projects, poor governance and corruption have consistently been considered the "most problematic issues."[24] Increasingly, large wind and solar projects will require a commitment to open public consultation to avoid conflict over natural resources or disagreements about aesthetics. Sensitivity to social concerns, such as employment creation and gender issues, can further bolster the acceptance of projects. In the case of solar home systems financed in Bangladesh under the RERED Project (see Case Study 2), acceptance of the system by women allowed greater market penetration.

Energy Efficiency

Disparities in the energy intensities of developing countries in comparison to the Organisation for Economic Co-operation and Development (OECD) industrial countries are large, and they offer short- to medium-term opportunities to improve energy efficiencies in the supply and

[24] Gian Casartelli, "The Role of the World Bank in Hydropower and Water Resources Optimization: The Views of the Industry" (Washington, D.C.: Prepared for the World Bank, 2007).

Box 3: Responding to Stakeholder Concerns in the Nam Theun 2 Project

Technical experts in the Nam Theun 2 hydropower project initially proposed resettlement halfway down the plateau because of superior soil quality. However, consultations revealed deep concern among the affected population rooted in spiritual and social values, leading to a change in the original plans. Experience suggests that the World Bank can play a vital role in this aspect of project development because of its convening power. While often acting as a magnet for international challenges, the Bank can also be instrumental in introducing principles of good practice and, through effective relationships, building lasting capacity and encouraging commitment by the Borrower.

end-use sectors. Despite the promising benefits of energy efficiency, achieving significant and sustained efficiency gains has proven to be a daunting challenge in all countries. The rate of implementation of energy efficiency policies and measures, as well as the deployment of energy efficiency technologies and best practices, lags well behind the opportunities that exist for

Testing of incandescent and compact fluorescent lamps at Electrogaz center in Rwanda. [When a customer returns incandescent lamps and buys CFLs, a project requirement is that both types of lighting be tested. This ensures the replacement of functioning incandescent lamps.]

energy savings in industry and other economic sectors. Many lessons have emerged from the cross-section of projects that the World Bank Group has implemented over the past several years, some of the most important of which are described further in the following sections.

Energy Efficiency Lesson 1: Convey the right message about how energy efficiency contributes to economic prosperity, focusing on important issues other than climate change mitigation. In the energy sector development agendas of most World Bank Group client countries, meeting basic energy needs at affordable prices and in a reliable manner is the first and foremost development priority. Therefore, promoting energy efficiency must come with a message that emphasizes the economic and social development benefits of energy efficiency.

Energy efficiency can generate significant, relevant economic dividends, including job creation, reduced exposure to energy supply volatility (fewer power cuts, less load shedding, fewer industries getting closed down), reduced vulnerability to energy price fluctuations, better health systems, lower crime rates,[25] and higher industrial and commercial competitiveness. However, these benefits are rarely measured or tracked, which has kept energy efficiency low on the list of priorities. If these positive elements are effectively conveyed to decision makers, though, energy efficiency could become an attractive option for the energy sector policies and action plans of many developing countries.

Energy Efficiency Lesson 2: Shift the emphasis of scaling up energy efficiency from developing technologies to delivering energy savings. The energy efficiency debate must shift its focus from developing energy efficiency technologies to realizing actual energy efficiency. Some sectors, such as industry, depend on technological innovation, which the World Bank Group supports directly or through financial intermediaries (see Box 4).

Certain other sectors have a mature energy efficiency technology profile, with products that could be made available in many developing countries (see Box 5). The challenge that energy efficiency sector development faces in developing countries lies mainly in finding innovative ways to get appropriate technologies into consumers' hands, which is what will

[25] Such as those observed in many of the household energy efficiency lighting projects (replacement of kerosene lamps, which generate toxic fumes indoors, with efficient CFL- or LED-based lighting systems) and energy efficiency street lighting projects (replacement of inefficient mercury vapor lamps, which produce poor-quality lights with efficient technologies based on high-pressure sodium vapor or LED lamps).

Box 4: Fostering Energy Efficiency Technology Innovation in the Industry Sector

The iron and steel industry is the second largest industrial user of energy. China accounts for 45 percent of energy use, partly because of its 34 percent share in the total world steel production. The IEA estimates that if the best available steel-making technologies were applied worldwide, the total energy savings potential would be almost 4.5 exajoules (nearly 20 percent). The World Bank's China Energy Efficiency Financing Project (IBRD, US$200 million, and GEF, US$13.5 million), approved in fiscal 2008, provides financing to two financing intermediaries in China—China Exim Bank and Huaxia Bank—that will onlend funds for energy efficiency improvements in the Chinese industrial sector, including the iron and steel industry. In addition, the US$12.9 million World Bank Carbon Finance Project approved in fiscal 2008 is aimed at helping switch China over to a more energy-efficient coke dry-quenching process in Baotou Iron and Steel Industry.

Box 5: From Energy Efficiency Technology to Delivering Energy Savings—The Missing Link

Estimates show that 30–40 percent energy savings can be achieved using currently available technology. For instance, 70 percent of global public and building lighting (which consumes 20 percent of total global electricity consumption) could use 50 percent less energy if current technologies were adopted, according to the IEA. More than 90 percent of streetlights around the world (including the industrial world) use technologies that are 40 percent more energy-intensive than the advanced high-pressure sodium vapor lamp, which has been commercially available for more than two decades. This technology is now being taken over by a third generation of technologies based on the efficient light-emitting diode (LED) and other high-efficiency fluorescent technologies for street lighting. On the appliances front, IEA estimates indicate that switching to the best available household appliances would save 40 percent of residential energy consumption, or US$130 billion per year in costs globally. The major constraints to increased energy efficiency financing and implementation are inherently institutional in nature.

actually deliver energy savings. The transport energy efficiency interventions in Thailand have demonstrated the need to clearly articulate the economic case for improving efficiency in a country's energy systems (see Case Study 8).

The IFC's experience with energy efficiency projects has clearly shown that the challenge is to create demand for existing energy efficiency technologies through increased awareness and consumer acceptance. Consumers at all ends of the spectrum must be familiar with the energy efficiency product and believe it works before they will accept an added cost risk. The ELI Initiative of the IFC and the World Bank Group's Lighting Africa program have demonstrated that marketing, consumer assurance, and some initial first-mover incentives can go a long way when it comes to scaling up implementation of energy efficiency technologies (see Case Study 1).

Energy Efficiency Lesson 3: Both regulatory policies and financial incentives are required to promote energy efficiency market transformation; appropriate emphasis and balance between the two will vary from one country to another. There is no single model for scaling up energy efficiency, especially when it comes to demand-side energy efficiency improvements. The greatest contributions come through systematic efforts to reduce the energy intensity of specific end-use sectors, and through efficiency improvements in technology, rational energy pricing, and market liberalization. The important approaches to scale up energy efficiency—(a) regulations and institutional governance structures that foster scale-up, (b) targeted financial incentives, and (c) knowledge sharing and information dissemination mechanisms—must be tailored to meet each different market situation.

For lights, motors, and buildings, mandatory energy efficiency policies (such as energy efficiency codes for building and equipment standards) can achieve much greater savings at a lower cost than financial incentives. This has not worked very well in developing countries, although some voluntary programs using financial incentives, such as many of the Bank's CFL bulk purchase-based utility DSM programs, have had better results in visibly shifting energy efficiency markets.

The major constraints to increased energy efficiency financing and implementation are

inherently institutional in nature.[26] A successful institutional framework for energy efficiency must take into account the country context; its technical and management capacity; new legislation and rules to enable energy efficiency investment; the level of integration between energy efficiency and other clean energy and clean development goals; the requirements for organizational autonomy, flexibility, and agility; and funding mechanisms.

Because energy efficiency financing has often involved small transaction sizes, one of the primary lessons learned at the IFC has been to work through financial institutions (see Box 6) and, where conditions are right, through microfinance.

In all situations, however, experience shows that meeting the energy efficiency scaling-up challenge requires strong coordination and cooperation among governments at every level, the international community, the private sector, and civil society. As in the case of the India Chiller Energy Efficiency Project (see Case Study 5), multiple resources can be used for projects that have various benefits, such as reductions in ozone-depleting substances, carbon emissions, and local pollutants. Such projects need the coordination of various monitoring and funding agencies.

Energy Efficiency Lesson 4: Carbon finance remains largely untapped as a major financial incentive to help scale up energy efficiency markets. Carbon finance, as an incentive mechanism, has not helped the energy efficiency agenda as much as was anticipated when flexible mechanisms, such as CDM, were conceived under the Kyoto Protocol. Barriers that energy efficiency traditionally faces are further exacerbated by complex and demanding CDM rules and procedures, such as complex monitoring and verification of savings associated with energy efficiency projects, and the earning of carbon revenues only after the project is implemented.

The share of energy efficiency in carbon markets needs to be augmented. First, energy efficiency initiatives in the carbon market must gradually transition away from project-based CDM to programmatic and sectoral crediting approaches to overcome barriers such as high

[26] Robert P. Taylor, C. Govindarajalu, J. Levin, A. Meyer, and W. Ward, "Financing Energy Efficiency: Lessons from Brazil, China, India and Beyond," ESMAP (Washington, D.C.: World Bank, 2008).

Box 6: The IFC's Energy Efficiency Interventions through the Financial Sector

Although energy efficiency opportunities exist as embedded components of larger projects across the entire spectrum of the IFC's core industry sector investment business, perhaps the greatest opportunities exist as smaller discrete projects, including cogeneration systems, lighting renovations, motor retrofits, and control systems. These projects are typically too small for direct IFC investments. Since 1998, the IFC has addressed this market opportunity by partnering with financial intermediaries to develop specialized financial products for promoting energy efficiency as a profitable, sustainable banking business—for example, the Russia Sustainable Energy Efficiency Program (RSEEP) worked with eight financial institutions to introduce energy efficiency finance in the Russian market, with a collective target of US$60 million for energy efficiency lending. The efforts of one such bank, Center-Invest Bank, which disbursed a US$4 million credit line within the first three months of the project's launch in 2005, was recognized at the 2007 Financial Times–IFC Sustainable Banking Awards. Similar initiatives are ongoing in China, Peru, and the Philippines.

transaction costs and complex measurement and verification of energy savings. Second, innovative financial engineering can be used to securitize future CDM revenue streams, including those after 2012. Although CDM will essentially remain a source of additional *ex post* revenue in energy efficiency projects, other existing incentive mechanisms, such as GEF and the Clean Technology Fund, can be effectively integrated upfront into the mainstream energy efficiency project financing.

Finally, in the case of project-based CDM, the focus on monitoring, which causes enormous burdens in demand-side energy efficiency projects that are small and dispersed, must shift to normative approaches, such as those based on deemed energy savings.

Case Study 3:
The IFC and World Bank Facilitate the Development of Wind Energy

Wind energy is growing rapidly with more than 120 GW now installed globally. Among developing countries, China leads the way with more than 12.2 GW installed, and India follows with about 10 GW. Other fast-growing wind markets include Brazil, Poland, and Turkey, with countries such as Bulgaria, Chile, Mexico, Morocco, and Romania poised for rapid growth in the next several years. Still others are either considering or have recently adopted wind tariffs, policies, or regulatory frameworks that will promote private sector–led wind development led by the private sector. This includes Egypt, Kenya, Pakistan, Peru, the Philippines, South Africa, Tunisia, and Ukraine.

The World Bank Group has proactively explored financing opportunities for wind projects. In the last few years, China and India have been the initial focus, given the rapid growth and relative maturity of these markets. In China, the world's fastest-growing wind market, the World Bank has financed more than 200 MW of wind farms, including the provision of carbon financing for a 100 MW project in Inner Mongolia. The IFC has financed a 30 MW wind farm in Fujian that utilizes 2 MW wind turbines manufactured locally by Vestas.

In India the IFC provided corporate financing to MSPL Limited, a leading mining company that is also a leading private wind developer, with more than 150 MW of wind projects that use mainly Suzlon wind turbines. The IFC's loan financing has helped MSPL finance 37 MW of new wind projects in Gujarat and Karnataka. Also in India, the IFC provided carbon financing to Enercon India Ltd., the Indian subsidiary of the German turbine manufacturer, for a series of wind farms. Wind farm financing was an important component of the World Bank's first large-scale renewable energy project, the India Renewable Resources Development Project.

More recently, the IFC has become active in less developed wind markets. In Chile, the government recently passed a new renewable energy law to encourage greater use of indigenous resources, including wind. To date, only two small wind farms that total 20 MW are installed and operational. Working together with SN Power, an established IFC client, and local developer Centinela, the IFC has provided US$30.75 million in debt financing for the first project-financed wind farm in Chile. The IFC also syndicated US$30.75 million in loans from DnB NOR of Norway. The project is a US$61.5 million 46 MW wind farm that uses 2 MW Vestas wind turbines, and it will be fully operational in 2009.

Bulgaria is another country that has put a regulatory framework in place to support wind under its 2007 renewable energy law. As a result, Bulgaria now has 158 MW of installed wind capacity. AES, another IFC client, has developed the €270 million 156 MW St. Nikolas wind farm in Kavarna. The project, which will be the largest wind farm in the country when fully commissioned, uses 3 MW Vestas wind turbines and reached financial closure in December 2008. The IFC worked with the European Bank for Reconstruction and Development (EBRD) and UniCredit on this transaction, which was also the EBRD's first wind project finance transaction.

Turkey has seen rapid growth of its wind sector from less than 50 MW installed in 2006 to more than 500 MW at present. This growth is being fueled by the country's tremendous wind resource potential, coupled with an attractive merchant power market driven by electricity supply shortages and a backstop government feed-in tariff for wind. Working with the local firm Zorlu Enerji, the IFC led project financing for a €222 million 135 MW wind project using 2.5 MW GE wind turbines to be located in Osmaniye

Construction under IFC-funded SN Power/Centinela wind project in Chile.

province in Southern Turkey. The IFC provided loan financing of €55 million, along with €45 million in loan financing from the EBRD, and €30 million from the European Investment Bank (EIB) to guarantee loan financings from HSBC and Denizbank. This project will increase Turkey's installed wind capacity by nearly 30 percent when commissioned later this year.

Mexico has a fully developed independent power producer (IPP) market with more than 20 projects and some 28 GW of conventional thermal power generation. The law also allows auto-generation of electricity by private firms. However, despite very significant wind potential and extensive project development efforts, Mexico's operational wind capacity stood at only 88 MW at the beginning of 2009. Nearly all of this capacity was from the first wind project, the 83.3 MW La Venta II Project in Oaxaca, which was supported by the World Bank. In Oaxaca, some 3.8 GW of private autogeneration wind projects are under development by experienced wind developers. About 300 MW of this capacity is now in construction or commissioning, but because of the global financial crisis, securing long-term project finance is now more challenging. The IFC is mobilizing up to US$15 million from the new Clean Technology Fund, administered by the World Bank to help support private wind development.

The IFC has helped its client, Transportadora de Electricidad SA (TDE), Bolivia's largest electricity transmission company, explore development of small- and medium-scale wind projects in Bolivia's rural regions to supplement local minigrids or serve as a source of stand-alone power as hybrid systems, together with diesel or other generation sources to provide rural electrification. However, Bolivia had no national scale wind data that allowed wind developers to identify projects based on a detailed knowledge of localized wind resources. The IFC and TDE, with support from 3Tier Environmental Forecast Group, prepared a national wind atlas using advanced mesoscale meteorological modelling. TDE is providing local support for data dissemination within Bolivia. This tool's new high-resolution wind maps should help spur wind development.

Case Study 4:
Lesotho Highlands Water Project—Good Governance and Communication for Large Hydropower Investments

The Lesotho Highlands Water Project (LHWP) supports water transfer from the water-abundant highlands of Lesotho to the Gauteng region of South Africa—the country's industrial heartland—and provides hydropower to Lesotho through a series of dams and weirs, delivery tunnels, and associated infrastructure in several phases. In addition, one of Lesotho's primary objectives regarding the LHWP is to use its export revenues to alleviate poverty and promote economic stability.

An emerging good practice in crafting sound governance and anticorruption strategies related to dam projects is to use a **coalition approach** during their preparation and implementation. To do this, all project stakeholders need to participate in different and complementary ways. The LHWP serves as a model of how bilateral government collaboration can strengthen political cooperation and lead to mutually beneficial development of an international river. It is vital to understand that development of strong political support for such projects is predicated on their acceptance as development opportunities by host communities. Community members must feel that they are full partners in the process, not simply residents of a bureaucratically chosen location for water resource projects designed to meet specific sectoral needs (such as water supply). The traditional approach often failed to consider the needs and desires of the local population, instead finding it sufficient to include project components that appropriately ameliorate environmental and social impacts.

From the perspective of governance with an emphasis on anticorruption, the LHWP has revealed the following lessons. In addressing corruption issues, **government political will** is important. In accordance with the Southern African Development Community (SADC) Protocol against Corruption, bribery should be criminalized and vigorously prosecuted. Anecdotal evidence points to the effectiveness of debarment in changing the culture of corruption, particularly in relation to contracts entered into by overseas corporations and agencies in developing countries, including those in the water sector. However, the **focus should be on prevention rather than prosecution**. The SADC Protocol against Corruption sets out a number of preventive measures and mechanisms to do this. According to Transparency International, good operating practice now requires that infrastructure (including water sector) projects include governance improvement plans based on corruption risk assessments at the national, sectoral, and project levels. More project-level support is needed to develop indicators of corruption. For example, the World Bank has identified

Lesotho Highlands Water Project.

the top 10 indicators relating to project-level fraud and corruption.

Another emerging good practice shows that **project developers and proponents must adopt good institutional governance practices**. A good example is the King II Report on Corporate Governance issued by the Government of South Africa, which has articulated a code of good corporate governance that, in addition to the LHWP, is finding regional acceptance in Botswana (by the Water Utilities Corporation) and South Africa. In relation to the institutional sustainability of Lesotho Highlands Development Authority, the principal lesson is that ongoing oversight is needed to assure that the Authority continues to act transparently and accountably in meeting its responsibilities, particularly in relation to the environmental and social aspects of the project.

Effective communication in all stages of the project cycle is critical to the success of complex hydraulic infrastructure projects, which involves many stakeholders. Communication is important on several levels, including during the advocacy stages to develop consensus on the need and type of measures to prevent and detect corruption, and to empower stakeholders to perform their roles. For example, consider nongovernmental organizations (NGOs) or associations in their capacities as watchdogs, as well as their promotion of a culture of disclosure, transparency, and accountability. Communication is properly embedded in the LHWP, inclusive of all stakeholders, and is instrumental in strengthening oversight of decision making across the program throughout its life. Effective, responsive management of complaints is a critical ingredient in establishing productive relationships between the project developer or sponsor and the host and other affected communities. Effective communication is an important ingredient in building support for a sustainable Environmental Flows (EF) policy. Communication is perhaps even more critical in the successful implementation of an EF policy involving an organization's management personnel, dam operators, and affected downstream communities, particularly when high dam flow releases are involved. Radio has proven to be an effective communications medium, particularly for isolated, poorer communities.

Finally, the World Bank has played a vital and longstanding role in facilitating the implementation of the LHWP. In relation to the corruption issues that surfaced during Phase 1A of the LHWP, the Bank played an important role in debarring two consulting companies that were convicted of bribery. The Bank assumed a successful facilitating role between South Africa and Lesotho in establishing in-stream flow requirements. Through its regular supervision of the project, the Bank assured that continued attention was paid to sensitive environmental and social issues through compliance with its safeguard policies. Political will at the management level is also important, particularly in relation to such projects as the Community Development Support Project, which was to support the Lesotho Fund for Community Development.

Case Study 5:
India Chiller Energy Efficiency Project—Reducing Greenhouse Gas and Chlorofluorocarbon Emissions Simultaneously

The objective of the India Chiller Energy Efficiency Project (CEEP) is to accelerate the replacement of centrifugal chillers with efficient non-chlorofluorocarbon—(CFC-) based centrifugal chillers. It promotes the wide-scale deployment of energy-efficient technologies to reduce GHG emissions and, at the same time, contributes to India's commitment under the Montreal Protocol to completely phase out new demand for ozone-depleting CFCs by 2010 and reduce the demand for recycled or reclaimed CFCs.

Financed by GEF and Montreal Protocol's Multilateral Fund (MLF) assistance of US$6.3 million and US$1 million, respectively, along with estimated carbon finance of US$5.85 million (through Clean Development Mechanism (CDM) credits under the Kyoto Protocol), this innovatively structured project aims to support the replacement of 370 CFC-based inefficient chillers used in commercial buildings and industrial establishments. Under this scheme, carbon credits generated by an initial group of 215 chiller replacements, funded through grant-based incentives of around 20 percent (of the total replacement cost) from GEF and MLF, would be used to provide further grant subsidies for another 155 chiller replacements. The main financial intermediary under CEEP, the Industrial Development Bank of India (IDBI), along with other domestic banks, provides the financing to chiller owners, manufacturers, and ESCOs. As a part of the Programmatic Framework Project for Energy Efficiency in India, the CEEP is estimated to reduce energy consumption of targeted chillers by 30 percent, thereby helping the Government of India meet its goal of increasing the overall energy efficiency by 20 percent by 2016–17. About 158 metric tons of CFCs from 370 chillers will be phased out over a 20-year period.

This pioneering model of integrating GEF and MLF assistance with carbon revenues obtained through a programmatic CDM approach will be replicated in the Philippines, where the World Bank is currently helping the government prepare a similar initiative aimed at replacing about 250 inefficient CFC-based chillers. According to the methodology approved by the CDM executive board, the CEEP is required to monitor data related to the power-output function of the old chiller to be replaced, electrical consumption of the new chiller, and cooling output in order to measure the energy savings and emissions reductions that are achieved.

The third component of the CEEP is technical assistance. To support project readiness and sustainability, this will focus on enhancing relevant stakeholders' awareness of energy conservation measures, improving understanding of the impact on the servicing sector of accelerating the phase-out of CFC production, and strengthening the capacity of chiller owners and other stakeholders to monitor the performance of new chillers and to undertake refrigerant management.

The fourth and the final component of the project is project management. A project management unit (PMU) will be established at a financial intermediary, namely the Industrial Development Bank of India (IDBI), and will be responsible for implementing all activities under the CEEP.

Chapter 3: Portfolio Review

This chapter examines the renewable energy and energy efficiency portfolio of the World Bank Group and discusses the dominant trends in the types of projects, regional outcomes, sectoral impacts, and achievements in analytical and advisory activities.

Financial Commitments

In fiscal 2009, the World Bank Group committed US$3.3 billion for energy efficiency and renewable energy projects, a 24 percent increase over the previous year and a historic high for the sector. This cemented the World Bank Group's role as a leading financier of clean energy in the developing world (Table 3). The World Bank Group committed US$1.7 billion for energy efficiency and US$1.6 billion for renewable energy, including US$177 million for hydropower projects where the capacity exceeded 10 MW per facility. Ninety-eight energy efficiency and renewable energy projects in 46 countries were supported, as well as one cross-border project in the Latin America and Caribbean Region. Projects in the past year have covered the spectrum of energy efficiency and renewable energy applications in a wide range of sectors (see Case Study 6 and the list of projects in Annex 3).

Total renewable energy and energy efficiency commitments during the fiscal 2005–09 Bonn commitment period was a record US$9.8 billion, or nearly four times the commitments made in the previous five years of US$2.5 billion (Table 4). Energy efficiency commitments of US$4.1 billion were five times the commitments during the previous five-year period. New renewable energy commitments of US$2.9 billion were nearly three times greater than in the previous five years. Large hydropower commitments at US$2.7 billion were 4.5 times the commitments in the preceding five-year period.

Since 1990, the World Bank Group has committed US$17.9 billion for energy efficiency and renewable energy—US$6.3 billion for energy effi-

Table 3: World Bank Group Renewable Energy and Energy Efficiency Commitments, FY2009
(millions of U.S. dollars)

	EE	*Hydro > 10 MW*	*New RE**	*Total*
World Bank	**1386**	**43**	**840**	**2,269**
IBRD/IDA	1,311	43	804	2,157
GEF	68	0	15	83
Carbon Finance	8	0	21	29
IFC	**315**	**135**	**587**	**1,036**
Own Funds	315	135	587	1,036
Total	**1,701**	**177**	**1,427**	**3,305**

* New RE comprises solar, wind, biomass, and geothermal, as well as hydropower with capacities up to 10 MW per facility.

Table 4: World Bank Group Renewable Energy and Energy Efficiency Commitments, FY2005–09
(millions of U.S. dollars)

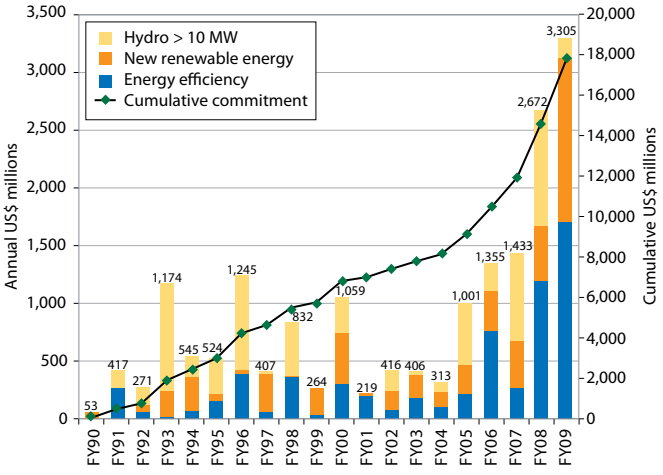
	EE	*Hydro > 10 MW*	*New RE*	*Total*
World Bank	**2,689**	**1,635**	**1,872**	**6,197**
IBRD/IDA	2,418	1,199	1,364	4,981
GEF	186	0	321	508
Carbon Finance	82	118	178	378
Others*	3	318	9	330
IFC	**1,404**	**862**	**948**	**3,214**
Own Funds	1,404	862	873	3,139
GEF	0	0	5	5
Carbon Finance	0	0	69	69
MIGA	**40**	**227**	**90**	**357**
Total	**4,133**	**2,724**	**2,910**	**9,767**

* Includes Guarantees, as well as Recipient Executed and Special Financing. Excludes CTF financing.

ciency and US$11.6 billion for renewable energy, including US$6.4 billion for hydropower projects of more than 10 MW per facility (Figure 5).

The share of renewable energy and energy efficiency as a portion of total World Bank Group energy lending has tripled from 13 percent in the fiscal 1990–94 period to 36 percent in the fiscal 2005–09 period (Figure 6). In fiscal 2009, energy efficiency and renewable energy commitments accounted for 40 percent of total World Bank Group energy commitments. These other energy commitments include traditional thermal generation and upstream oil, gas, and coal projects, but also transmission and distribution projects and development policy lending that create enabling environments for energy efficiency and renewable energy projects.

Figure 5: World Bank Group Energy Efficiency and Renewable Energy Commitments, FY1990–2009



Source: World Bank Group data.

Going Beyond the Bonn Commitment

In June 2004, at the International Conference on Renewable Energies held in Bonn, Germany, the World Bank Group promised to increase its commitments for new renewable energy and energy efficiency by 20 percent per year from a baseline of US$209 million during the fiscal 2005–09 period. Hydropower plants that generate more than 10 MW per facility are classified separately

from "new renewable energy," since they do not count toward the Bonn commitment.

Cumulatively, in fiscal 2005–09, the World Bank Group committed US$7.0 billion for energy efficiency and new renewable energy projects covered by the Bonn commitment (Table 5). An additional US$2.7 billion was committed for hydropower plants that exceed 10 MW per facility. The US$7 billion in financing achieved exceeds the cumulative US$1.9 billion commitment promised at Bonn in 2004 by 277 percent.

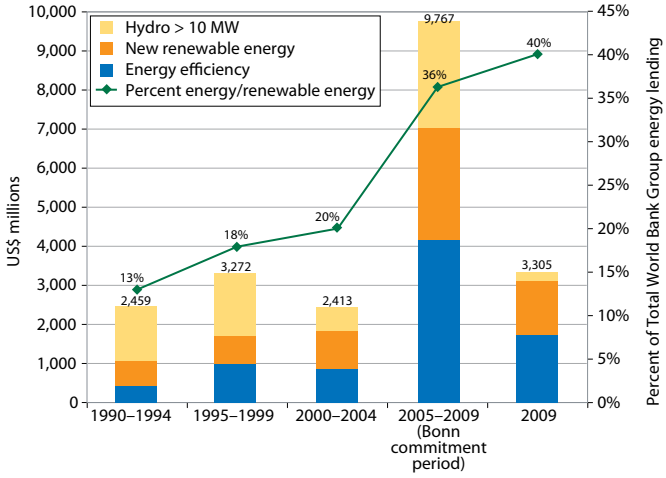
Portfolio Characterization—Technology

At US$1.7 billion, energy efficiency contributed the largest share to the World Bank Group's clean energy portfolio in fiscal 2009, rising 43 percent over the previous year. Even though fuel prices have fallen from recent record highs, concerns about future price volatility and power shortages have driven worldwide interest toward using energy more efficiently.

Six of the 56 energy efficiency projects this year exceeded US$100 million in World Bank Group financing. They ranged from improvements to existing power plants to incentives and financing provided to encourage energy efficiency in the private sector. For example, the US$125 million Belarus Energy Efficiency Project will convert six decades-old boilers from providing heat only to combined heat and power plants, decreasing Belarus' demand for imported natural gas and increasing energy security. In Nigeria, the US$182 million Electricity and Gas Improvement Project will refurbish existing transmission and distribution lines, and reduce losses.

New renewable energy was the second largest contributor to the World Bank Group's clean energy portfolio in fiscal 2009, tripling from the previous year to US$1.4 billion in new commitments. The new renewable energy projects in fiscal 2009 included projects generating energy from solar PV, biomass, wind and hydropower plants up to 10 MW in size.

Figure 6: Trends in Renewable Energy and Energy Efficiency Commitments



Source: World Bank Group data.

Table 5: Measuring Progress in Energy Efficiency and New Renewable Energy Lending against Bonn Targets
(millions of U.S. dollars)

RE and EE achievements and targets	*Average FY02–04*	*FY05*	*FY06*	*FY07*	*FY08*	*FY09*	*FY05–FY09*
Actual new RE and EE	**209**	463	1,105	682	1,665	3,128	**7,043**
Bonn commitment target		251	301	361	433	520	**1,866**
Hydro > 10 MW (not in Bonn commitment)	96	538	250	751	1,007	177	**2,724**

One of the largest and most innovative projects this year, the US$103 million China Eco-Farming Project, will enable nearly half a million rural households to use biogas from their small farms to cook food. Another 30,000 larger biogas digesters installed as part of the project will provide heating for homes and fertilizer for farms, leading to 60,000 fewer tons of carbon dioxide emissions per year. In Vietnam and Turkey, the World Bank Group made available US$500 million that will be lent out by local financial institutions for small renewable energy investments by rural and urban communities, as well as by small businesses seeking environmentally friendly energy for development.

This year, the World Bank Group lent US$177 million for large hydropower projects, the largest single share of which was the IFC's US$100 million loan to support the privatization and rehabilitation of Ambuklao and Binga, two hydroelectric power plants in the Philippines. The combined capacity of Ambuklao and Binga will increase by 50 MW to a total of 225 MW. The two plants will provide enough clean energy to meet the energy needs of 350,000 people, as well as industrial and commercial users, starting next year.

Portfolio Characterization—World Bank Group Institutions

The International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA) continued to be the largest financiers of energy efficiency and renewable energy, accounting for nearly two-thirds of all new commitments in fiscal 2009 and increasing over 60 percent from the year before. The IFC also increased clean energy lending to more than US$1 billion, and two out of every three dollars invested in energy by the IFC went to an energy efficiency or renewable energy project.

From fiscal 2005, when the Bonn commitment went into effect, to fiscal 2009, the World Bank committed US$2.7 billion for energy efficiency and US$1.9 billion for new renewable energy, as well as an additional US$1.6 billion for large hydropower projects. In the same time frame, the World Bank also offered US$330 million in guarantees, recipient-executed financing, and special financing to client countries for energy efficiency and renewable energy. US$318 million of this was for large hydropower plants.

The IFC committed US$1.4 billion for energy efficiency and US$950 million for new renewable energy during the fiscal 2005–09 period, and financed an additional US$860 million of large hydropower projects. The IFC's experience has shown that energy efficiency and renewable energy options are increasingly price-competitive with traditional fuel options, and there is growing demand from the private sectors of client countries for the World Bank Group to scale up its engagement in such clean energy options.

The Multilateral Investment Guarantee Agency (MIGA) was instrumental in providing guarantees for private investment in energy efficiency and renewable energy projects during the Bonn commitment period, offering US$130 million for Bonn commitment-covered projects, as well as US$230 million for large hydropower projects.

The GEF and the Carbon Finance Unit are important partners and prime enablers in financing energy efficiency and renewable energy projects at the World Bank Group. During the fiscal 2005–09 period, GEF committed US$510 million for energy efficiency and new renewable energy projects, while the Carbon Finance Unit committed US$260 million during the same period, as well as US$120 million for large hydropower projects.

In fiscal 2009, the Clean Technology Fund approved investment plans for three coun-

Box 7: The First Clean Technology Fund Project

In May 2009, the Board of the World Bank Group approved the Turkey Private Sector Renewable Energy and Energy Efficiency Project, a US$600 million project, with US$100 million financed by the Clean Technology Fund. Through two Turkish development agencies—the Turkish Industrial Development Bank (TSKB) and the Turkish Development Bank (TKB)—the project will offer low-cost financing to private firms in Turkey seeking to develop indigenous renewable energy sources, such as wind, solar, biomass, small hydropower plants and geothermal sources. Additionally, financing is available to both public and private institutions that want to make significant energy efficiency investments.

"Turkey's Renewable Energy and Energy Efficiency Project will help enhance energy security, support a clean energy transition, and increase private sector involvement in the development and financing of clean energy and energy efficiency investments," said Ulrich Zachau, Country Director for Turkey. "The project establishes a financial mechanism through Turkish banks that will assist Turkish entrepreneurs in leveraging their capital to economically develop renewable resources. We are very pleased to be able to support this innovative project, and we are especially happy that this project will be the first to receive low-interest funding from the Clean Technology Fund for renewable energy resource development."

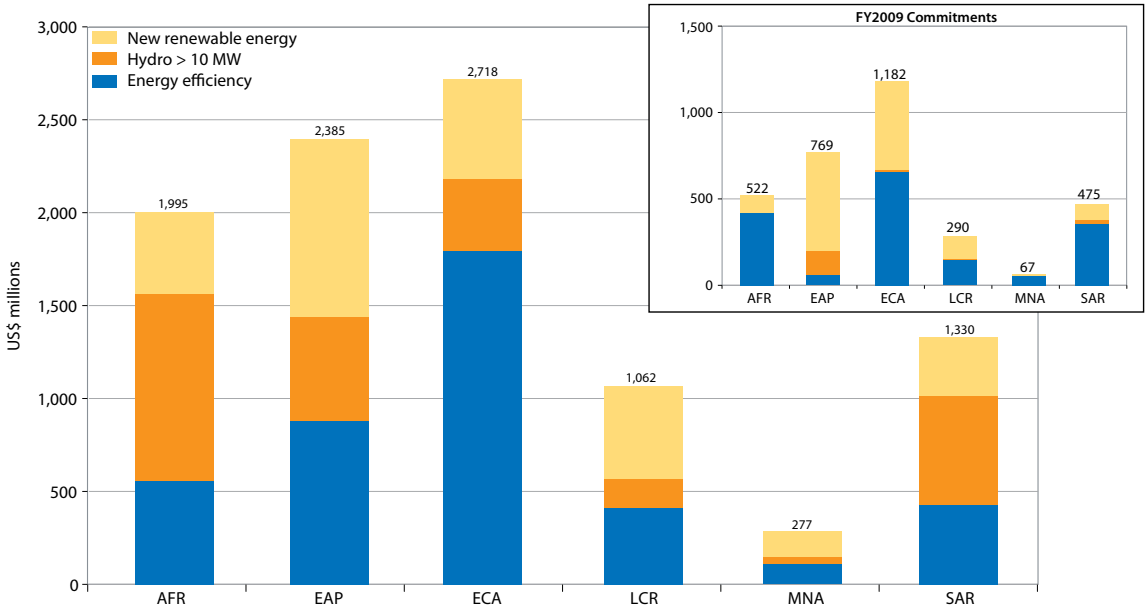
tries—Egypt, Mexico, and Turkey; 12 more plans are expected to be approved soon. The Private Sector Renewable Energy and Energy Efficiency Project in Turkey, approved in fiscal 2009, received US$100 in Clean Technology Fund financing to support the US$500 financing provided by the World Bank Group. See Box 7 for further details.

Region-wise Commitments

Eastern Europe and Central Asia saw the greatest number of new commitments in both fiscal 2009, totaling US$1.2 billion, and over the entire fiscal 2005–09 Bonn commitment period, totaling US$2.7 billion (Figure 7). More than half the commitment in Eastern Europe and Central Asia during the Bonn commitment period was for energy efficiency projects, such as the 2006 Electricity Generation Rehabilitation and Restructuring in Turkey. This project overhauled one of the country's largest thermal power plants to increase power output while bringing the plant into compliance with some of the strictest environmental standards ever applied to thermal power plants.

Solar lanterns financed under the Lighting Africa Development Marketplace project in Liberia.

Figure 7: World Bank Group Commitments by Region, FY2005–09



Source: World Bank Group data.

In East Asia and the Pacific, lending reached US$770 million in fiscal 2009 and US$2.4 billion for the entire Bonn commitment period. Projects such as the 2009 Vietnam Renewable Energy Development Project have encouraged bottom-up development by letting communities apply for grants and loans from local financial institutions to make investments in smaller, cost-effective, renewable energy systems that directly benefit communities.

In Sub-Saharan Africa, the World Bank Group committed US$520 million for energy efficiency and new renewable energy in fiscal 2009, and US$2 billion during the entire Bonn commitment period, with electricity access through renewable energy taking center stage. In 2007, the 250 MW Bujagali Hydropower Project in Uganda drew upon resources from across the World Bank Group—including financing from the IFC and guarantees from the World Bank. Projects such as the 2008 Olkaria II Geothermal Expansion Project will add a much-needed 35 MW of clean geothermal power in Kenya and reduce carbon dioxide emissions by 156,000 tons per year. Other projects such as the 2009 Mali Energy Support Project targeted technical issues to minimize the technical energy loss between power stations and end users.

In South Asia, the World Bank Group committed US$480 million in fiscal 2009 for energy efficiency and renewable energy for projects such as the Coal-Fired Generation Rehabilitation Project (2009), which aims to increase efficiency at six major thermal power plants across India. During the entire Bonn commitment period, the World Bank Group committed US$1.3 billion in South Asia. The largest single project was the 2008 Rampur Hydropower Project, a 412 MW hydropower plant expected to reduce carbon dioxide emissions by 2 million tons per year (compared to an equivalent thermal plant), and to provide 40 percent of the power needs of the Indian state of Himachal Pradesh.

In Latin America and the Caribbean, the World Bank Group committed US$290 million for energy efficiency and renewable energy projects in fiscal 2009, and US$1.1 billion during the fiscal 2005–09 Bonn commitment period. Renewable energy has been the largest component of the World Bank Group's commitments in the region. The Argentina PERMER Renewable Energy financing project, which has been active since 1999, provides small-scale renewable energy systems that can deliver energy to rural households and schools. Despite financial turmoil in the region in the first part of the decade, the project achieved its household electrification goals. In fiscal 2009, the World Bank Group renewed its commitment with a fresh US$50 million commitment that will finance the installation of an additional 19,000 solar, wind, and mini-hydropower systems.

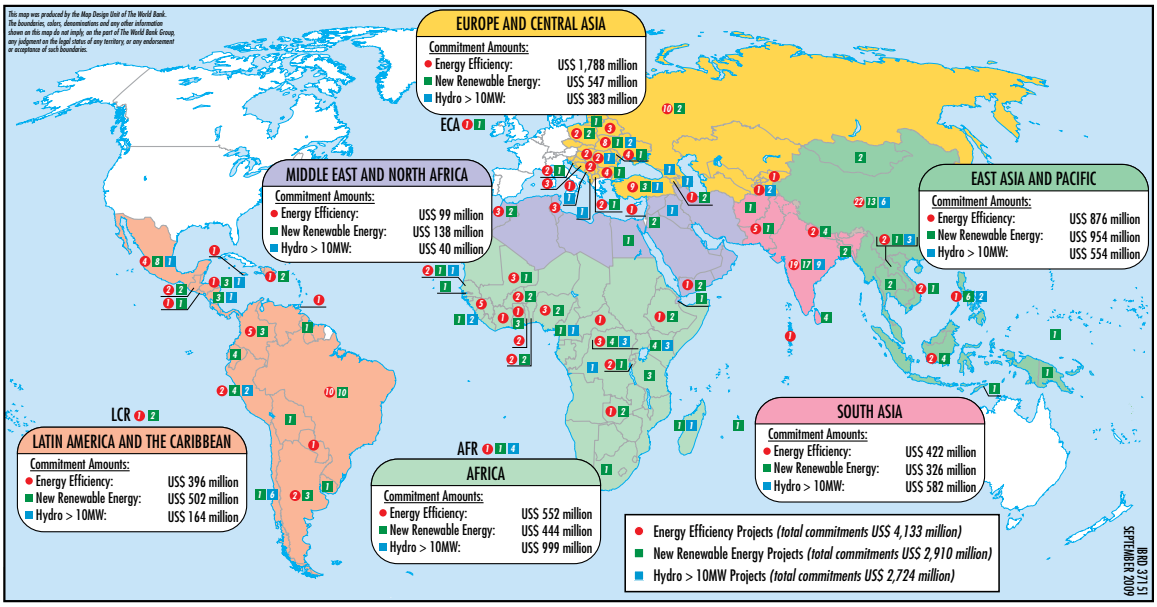
In the Middle East and North Africa, the World Bank Group committed US$280 million during the Bonn commitment period, including US$67 million in fiscal 2009. Projects such as the 2008 Egypt Kureimat Solar Thermal Hybrid Power Plant provide electricity with significantly less of an environmental impact compared to conventional thermal plants.

In fiscal 2009, 99 projects were approved in 46 countries (see Table 6). During the fiscal 2005-09 Bonn commitment period, 364 projects were supported in 85 countries. Several projects spanned national borders, particularly in the Eastern Europe and Central Asia, Latin America and the Caribbean, and Sub-Saharan Africa regions (see Figure 8).

Table 6: Region-wise Distribution of Projects, FY2005–09
(numbers of projects)

		FY2005–09		
Regions	*EE*	*Hydro > 10MW*	*New RE*	*Total*
Sub-Saharan Africa	25	14	27	**66**
East Asia and Pacific	28	11	27	**66**
Europe and Central Asia	56	10	14	**80**
Latin America and Caribbean	32	11	38	**81**
Middle East and North Africa	6	1	7	**14**
South Asia	26	7	24	**57**
Total	**173**	**54**	**137**	**364**
		FY2009		
Regions	*EE*	*Hydro > 10MW*	*New RE*	*Total*
Sub-Saharan Africa	11	0	6	**17**
East Asia and Pacific	4	3	9	**16**
Europe and Central Asia	13	2	5	**20**
Latin America and Caribbean	9	2	11	**22**
Middle East and North Africa	1	0	2	**3**
South Asia	15	1	5	21
Total	**53**	**8**	**38**	**99**

Figure 8: Distribution of World Bank Group Renewable Energy and Energy Efficiency Projects Worldwide FY2005–09



A detailed breakout of the commitments by region is given for new renewable energy, efficiency, and large hydro for fiscal 2009 in Figure 9.

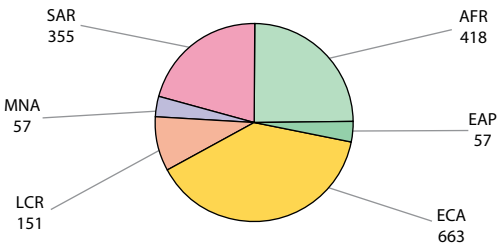
Outcomes and Impacts

Rural and urban communities, small and large industries, public and private institutions and, most importantly, people in general have benefited from the myriad of renewable energy and energy efficiency projects supported by the World Bank Group. As they have increased access to electricity, reduced energy consumption and peak loads, and improved fuelwood supplies, the projects have also ameliorated the economic condition of people, increased productivity, and reduced indoor pollution and global carbon emissions. They have strengthened the capacities of public institutions and enabled domestic industries and financial institutions to deliver renewable energy and energy efficiency products and services more effectively and at scale. Throughout this and previous renewable energy and energy efficiency progress reports, case studies and text boxes illustrate the many and varied ways the projects have improved lives. The examples given below provide a glimpse at the variety and breadth of the World Bank Group's efforts to bring the benefits of renewable energy and energy efficiency to the developing world.

- In about 30 countries, more than 2.5 million households, businesses, and community facilities will benefit from access to modern electricity services from off-grid PV, small wind, micro-hydropower, and biomass-electric technologies. By replacing kerosene, candles, and disposable batteries, these projects are improving the quality and reducing the cost of lighting, increasing the safety of people, and reducing indoor pollution in countries as varied as Argentina, Bangladesh, Bolivia, China, Mali, Nicaragua, Papua New Guinea, and Uganda. PV for health facilities, rural schools, community centers, and streetlights are improving the

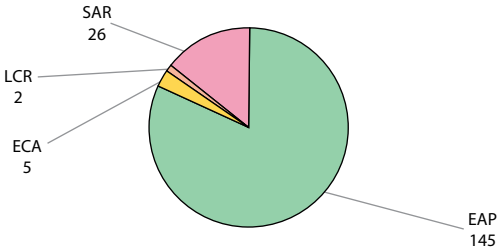
Figure 9: Commitments by Region and Type, FY2009

Energy Efficiency Commitment by Region
Total: US$1,701 million



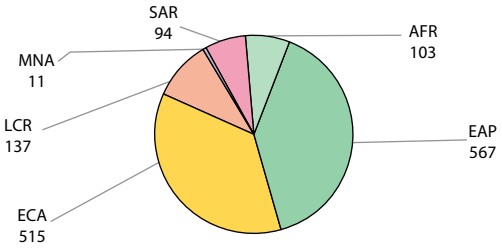
Energy efficiency lending grew 42 percent to US$1,701 million in fiscal 2009 from US$1,192 million in fiscal 2008, a new record for the World Bank Group. The Eastern Europe and Central Asia Region saw the largest new commitments for energy efficiency in fiscal 2009, representing nearly 40 percent of all World Bank Group energy efficiency commitments, with projects that improved energy efficiency in both industrial and residential buildings, as well as in older power plants.

Hydro > 10MW Commitments by Region
Total: US$177 million



Hydropower plants with a capacity greater than 10 MW fell sharply from US$1,007 million in fiscal 2008 to US$177 million in fiscal 2009. This reflects the variation in such projects over time because of the "lumpy" nature of large hydropower projects. The East Asia and Pacific Region accounted for almost all of the projects, with more than 80 percent of World Bank Group commitments for large hydropower plants. In fiscal 2009, the World Bank Group's largest investment in hydropower was the IFC's US$100 million loan to rehabilitate two hydroelectric plants in the Philippines, with the goal of expanding energy output from an environmentally friendly source, while supporting the country's efforts to privatize the power sector.

New Renewable Energy Commitments by Region
Total: US$1,427 million



New renewable energy trebled to US$1,427 million in fiscal 2009, from US$473 million in fiscal 2008. The East Asia and Pacific Region and the Europe and Central Asia Region each contributed more than a third of the total portfolio. Commitments were for projects in biomass, hydropower with less than 10 MW per facility, solar PV, and wind projects.

delivery of critical social services in African and Asian countries.

- Industrial and commercial sector energy efficiency improvements are enhancing productivity and profitability while reducing pollution. Waste-to-energy projects are simultaneously reducing solid waste pollution, contributing to a reduction in emissions of global warming gases, and earning additional revenues from carbon emissions trading and energy sales. District heating investments, especially in Europe and Central Asia, are improving living conditions, reducing the depletion of forest resources close to population centers, and reducing the costs of meeting the heating needs of these

Children at solar-powered Hayes Mission School in Liberia.

countries. Rehabilitation of power plants and reducing transmission and distribution losses are not only reducing the cost of providing electricity services in numerous countries and improving the reliability of electricity supplies, but also reducing local and global pollution.

- Massive programs that distribute millions of CFLs in such countries as Bangladesh, Mexico, Rwanda, and Uganda are reducing peak loads and averting the need for expensive and emergency generation. The Lighting Africa Program is catalyzing the large-scale adoption of LED and other high-efficiency and advanced lighting technologies to benefit the 500 million Africans who are dependent on kerosene and candle lighting. The Efficient Lighting Initiative—born and nurtured at the IFC—is now recognized as a high-quality program essential to bringing the best-performing lighting to developing countries.
- Grid-connected renewable energy projects in a large number of countries are not only increasing electricity supplies in an environmentally sound manner, but also building new industrial capabilities, engaging local commercial banks in a new business, and creating high-technology and high-value employment. The mini-hydropower projects that were financed in Sri Lanka both created a new private industrial sector—which currently contributes more than 4 percent of total electricity generation—and spawned a population of entrepreneurs, who are now investing in and building similar projects in several African countries. Geothermal projects in Djibouti, Kenya, and the Philippines;

Hydropower plant in Thailand.

wind projects in Jordan and Costa Rica; large-scale renewable energy projects, such as 100 MW wind farms in China, the 80+ MW wind farm in Mexico, the concentrating solar power projects in Egypt, and Morocco; and the financing of large renewable energy portfolios through financial intermediaries in Turkey, Vietnam, and elsewhere are accelerating the adoption of advanced renewable energy technologies in developing countries.

- Engagement of the private sector in large-scale hydropower projects is ensuring that the projects benefit local communities, and that they are built and managed in an environmentally and socially sound manner. The Bujagali project in Uganda, the Nam Theun 2 project in Lao PDR, and the Hidroelectrica La Higuera project in Chile are a few examples.
- Technical assistance and capacity building services supported by the World Bank Group are having tremendous catalytic effects in scaling up the use of renewable energy and energy efficiency. Standardized power purchase agreements are reducing transaction costs and project development risks during the development of grid-tied renewable energy generation projects in Sri Lanka, Tanzania, Uganda, and Vietnam. National low-carbon strategies in some of the highest carbon-emitting countries are guiding their energy sectors in a more sustainable development direction. Introduction of good practices through the REToolkit, the large-scale CFL dissemination toolkit (forthcoming), and the operational guidance on off-grid electrification project development are facilitating the wider use of such

technologies and improving the long-term sustainability of projects. Building efficiency standards and appliance labeling programs are further improving the built environment and living standards.

These are but a snapshot of the benefits that developing countries are accruing from World Bank Group renewable energy and energy efficiency projects. Going forward, the World Bank Group will build on these experiences, the strengthened capacities of client countries, and the growing confidence in deployed technologies to bring economically beneficial and environmentally sustainable energy to the developing world.

Africa Renewable Energy Access Grants Program

The Africa Energy Unit (AFTEG) of the World Bank has established a strategic plan to support efforts by Sub-Saharan African countries to expand the access of their citizens to affordable, reliable modern energy services. This strategic plan—the Africa Energy Access Scale-Up Plan—seeks to augment household electrification programs, provide greater and more sustainable access to cleaner fuels, expand power generation and transmission capacity, broaden the provision of energy services to key areas of the public sector, and connect households previously without electricity service while improving access to standalone lighting services. To meet the large funding needs projected for the strategic plan, AFTEG collaborated with the Energy Sector Management Assistance Program (ESMAP) to mobilize multiyear funding commitments through ESMAP's Consultative Group members. In fiscal 2009, the Netherlands dedicated US$28.75 million to support AFTEG's analytical and technical assistance programs in order to create an environment conducive to the deployment of renewable energy systems through the Africa Renewable Energy Access Grants Program (AFREA).

LED lighting street vendor in Monrovia, Liberia.

AFREA aims to meet the energy needs of Sub-Saharan African countries and widen their citizens' access to energy services in an environmentally responsible way (see Case Study 7). The program improves public and private sector capacity for renewable energy projects in the region, catalyzes additional investment for renewable energy, and expands access through these renewable energy projects. Such activities further AFTEG's mission by (a) directly supporting or creating conditions conducive to increased renewable energy investments and (b) expanding access to modern energy services in Sub-Saharan Africa. AFREA also funds recipient-executed pre-investment activities that are intended to accelerate deployment of renewable energy systems based on hydro, wind, geothermal, and solar energy resources.

Some examples of major programs supported by AFREA follow.

Lighting Africa: This joint World Bank–IFC initiative is funded by AFREA, ESMAP, GEF, Public Private Infrastructure Advisory Facility (PPIAF), and other donors. It works with the private sector, governments, and NGOs in Sub-Saharan Africa to develop and disseminate low-cost, clean, and efficient modern lighting solutions using LED and other efficient lighting technologies for the 500 million Africans who currently rely on kerosene or other forms of inefficient and polluting fuel-based lighting. AFREA has provided financing of about US$200,000 each for three of the Lighting Africa Development Marketplace winners for innovative design and delivery of low-cost, high-quality, non–fossil fuel–based lighting products targeting off-grid, low-income consumers in Sub-Saharan Africa. A total of US$2.5 million has been allocated to support components of the Lighting Africa program, including improving quality and market development support.

Biomass Energy Initiative for Africa: AFREA is financing efficient, clean, and sustainable pilot biomass energy projects in Sub-Saharan Africa. AFREA will provide US$1.8 million to support about 15 pilot projects. Additionally, this activity will also serve as a platform for AFTEG to formulate a comprehensive, coherent, and effective biomass energy modernization strategy for Sub-Saharan Africa.

Benin Increased Access to Modern Energy Project: AFREA has allocated US$2 million to support efforts that reduce deforestation and increase access to and options for renewable energy and cleaner fuels for households and small and medium enterprises. The project will promote a community-based sustainable fuelwood production and market management system covering 300,000 hectares of forests in the Moyen Oueme region, and encourage biomass energy efficiency and interfuel substitution.

Rwanda Grants: A US$3.8 million grant to Rwanda by AFREA will support the preparation of strategy studies on deployment of renewable energy systems, such as PV and solar thermal technologies.

Africa Electrification Grants: AFREA is supporting a US$3.3 million program in Liberia to establish a Rural and Renewable Energy Agency. The agency will be able to mobilize new renewable energy services and investment for rural areas to meet demand in a reliable and affordable manner. Pilot projects supported by the agency include the construction of one run-of-river micro-hydropower plant and two solar village electrification networks that provide electricity services to key public facilities, as well as households and businesses. AFREA is planning to offer similar financing to countries such as Kenya and Mali.

Sector-wide investment and policy prospectus: AFREA is helping several governments in Sub-Saharan Africa develop comprehensive, sector-wide access expansion programs with the use of new planning tools, such as geo-referenced least-cost expansion plans. The first Investment and Policy Prospectus, developed for Rwanda, resulted in US$357 million in donor commitments to a sector-wide program. Similar programs are in development for other Sub-Saharan African countries, including Kenya, which aims to draw US$900 million in donor commitments.

The Asia Sustainable and Alternative Energy Program

ASTAE

The Asia Sustainable and Alternative Energy Program (ASTAE) was created in January 1992 with a mandate to improve

energy efficiency, scale up the use of renewable energy, and increase access to energy to reduce poverty. ASTAE is currently funded by the World Bank Group, the Government of the Netherlands, and the Swedish International Development Agency. ASTAE currently supports three major types of activities: introducing innovative investment delivery mechanisms, developing institutional and regulatory frameworks that provide enabling environments to scale up investment projects, and building capacity and sharing knowledge across countries and sectors.

ASTAE has developed a strong portfolio of technical assistance activities in the East Asia and Pacific region, supporting the implementation of large World Bank Group investment projects and GEF grants. In fiscal 2009, ASTAE disbursed US$2.1 million, funding 25 activities in 12 countries. During fiscal 2005–09, ASTAE financed 84 activities with a total of US$8 million. ASTAE's work over these five years catalyzed 1,300 MW of renewable energy capacity, and nearly 6 TWh of electricity saved through energy efficiency. Recent examples of ASTAE's work include the following:

Innovative Financing Mechanisms: ASTAE has supported the development of onlending guidelines for energy efficiency in China, has structured onlending funds for renewable energy development in Vietnam, and has helped both neighboring countries adopt best practices and business models to encourage energy efficiency financing from one another. ASTAE also helped introduce risk guarantees for private sector financing of access expansion projects in the Pacific Islands and private sector energy efficiency projects in Thailand. ASTAE's support for these financing mechanisms has opened new avenues for donors to contribute to increasing access and promoting a low-carbon growth path for the countries of East Asia and the Pacific.

Institutional and Regulatory Frameworks: ASTAE has provided long-term support for the development of renewable energy legislation in China, assisted in the development of pricing policy and regulation to support increased access to energy in Mongolia, and helped design and implement standards for energy efficiency in Thailand and Vietnam. Such work is essential to ensuring that gains in access or low-carbon energy are sustainable and expandable.

Cross-Sector, Cross-Country Capacity Building and Knowledge Sharing: As a result of its successful contributions to project and program design and implementation, ASTAE is able to draw from a pool of experts to provide timely advice to leverage new project development in the region. Recent support has included training seminars for officials and policy makers in China, Indonesia, Thailand, and Vietnam; South-South technical workshops between China and Vietnam; and development of knowledge products, technical guides, and methodologies.

Major Project Achievements: ASTAE's portfolio of renewable energy projects include the long-term US$600,000 China Renewable Energy Scale-Up Program that led to the Chinese Renewable Energy Law, as well as the US$400,000 Indonesia Geothermal Power Program that provided technical assistance to review, design, and build consensus on policy reforms in the geothermal sector, so that Indonesia could reach its goal of 6,000 MW of geothermal capacity by 2020. ASTAE also supported the US$900,000 China Energy Conservation I and II and China Energy Efficiency Financing I and II projects to help create an energy service industry, establish energy efficiency business lines in Chinese banks supported by partial risk guarantees, and create a financing facility through which Chinese commercial banks might pool their funds to finance energy efficiency.

The Energy Sector Management Assistance Program

The Energy Sector Management Assistance Program (ESMAP) is a global knowledge and technical assistance partnership administered by the World Bank and sponsored by bilateral official donors since 1983. ESMAP's mission is to help clients from low-income, emerging, and transitional economies secure energy requirements for equitable economic growth and poverty reduction in an environmentally sustainable way. ESMAP activities are executed by its clients and/or by World Bank staff.

ESMAP follows a three-pronged approach to achieve its mission: think tank or horizon-scanning, operational leveraging, and knowledge clearinghouse functions. The last includes generating and disseminating new knowledge; holding training and learning events; organizing and facilitating workshops, seminars, conferences, and roundtables; maintaining a website; and publishing a newsletter and other work. ESMAP focuses on three global thematic energy challenges: expanding energy access for poverty reduction, enhancing energy efficiency for energy secure economic growth, and deploying renewable energy systems for a low-carbon global economy.

ESMAP supports regional activities to provide better services—as well as cutting-edge research and global projects—to individual developing countries. The program also supports collaboration across the energy sector and shares ideas, good practices, and project experiences across regions. Some highlights of fiscal 2009 follow.

Lighting Africa: ESMAP is a major contributor to the Lighting Africa Program. It has supported off-grid lighting market research in five African countries, quality testing of solar lanterns, development of a quality assurance program for advanced off-grid lighting technologies, five Development Marketplace Recipients (each with approximately US$200,000 in funding), and the first International Conference on Off-Grid Lighting held in 2008 in Accra, Ghana.

Renewable Development and Market Reform in the Philippines: Recognizing that renewable energy will play a major role in achieving energy security and meeting its growing energy demand, the Government of the Philippines enacted a renewable energy law in October 2008. The Renewable Energy Law lays out a framework to accelerate the development and utilization of renewable energy resources and, in parallel, establishes an institutional framework and a series of mechanisms fulfill its mandate. ESMAP is providing support to the Energy Regulatory Commission of the Philippines to develop a sound regulatory framework that will encourage the sustainable development of renewable energy sources.

Hydropower in Peru and Nepal: In Peru, ESMAP is funding the development of a framework for hydropower investments. The project will assess the role of hydropower in the country's energy mix and develop an appropriate operational framework to facilitate public-private investment in the hydropower sector. It will help build consensus on the appropriate role of the public sector in hydropower development and will propose appropriate mechanisms for public sector involvement. Nepal is seeking to assess the longer-term strategic options and attendant risks for the efficient development of its hydropower potential. ESMAP has initiated a study to identify barriers to hydropower development in Nepal and to propose recommendations to remove or reduce the impact of these barriers, so as to contribute to efforts to realize the economic benefits that might come with development of the country's huge hydropower potential.

German Trust Fund for Scaling Up Energy Efficiency: In fiscal 2009, the German Trust Fund financed 34 energy efficiency activities. These activities covered multiple sectors ranging from policy and regulation reform to strategy and toolkit development. This work will enhance the capacities of ESMAP's clients, inform the design of sound energy efficiency strategies, and scale up energy efficiency improvements. ESMAP funded a study to examine energy intensity and explore options to boost energy efficiency in the Middle East and North Africa region. It is expected that the World Bank Group will support lending projects generated by this initiative. Additional energy efficiency studies were carried out in Brazil, China, Egypt, Nepal, Syria, Vietnam, and the countries of the Western Balkans, including Albania, Bosnia-Herzegovina, Kosovo, Macedonia, Montenegro, and Serbia.

Energy-Efficient Cities Initiative. Cities are an important engine for economic growth and socioeconomic development, and rapid urbanization will lead to massive requirements for new energy supplies. ESMAP launched its Energy-Efficient Cities Initiative (EECI) to help scale up energy efficiency improvements in developing country cities around the world. The EECI includes support for (a) analytical work, including tools; (b) city grants; (c) a project database and innovation awards; (d) project support for Bank investment lending; and (e) outreach and partnerships. The EECI is leveraging World Bank lending and pursuing global partnerships in order to help cities grow in a more sustainable manner. The program was launched at the ICLEI Local Government Climate Session side event at COP-14 in December 2008 (Poznan, Poland) following a Practitioners Roundtable co-hosted by ESMAP and the Urban Anchor of the World Bank, an event that brought together client cities, potential partners, and other practitioners to share experiences and identify remaining gaps.

Carbon Finance

The World Bank Carbon Finance Unit uses funds contributed by governments and companies in OECD countries to purchase project-based GHG emission reductions in developing countries and countries with economies in transition. The emissions reductions are purchased on behalf of the contributor through one of the Carbon Finance Unit's carbon funds, within the framework of the Kyoto Protocol's Clean Development Mechanism or Joint Implementation.

Unlike other World Bank development products, the Carbon Finance Unit does not lend or grant resources to projects, but rather contracts to purchase emissions reductions similar to a commercial transaction, paying for them annually or periodically once they have been verified by a third party auditor. The selling of emissions reductions—or carbon finance—has been shown to improve the financial viability of projects by adding an additional revenue stream in hard currency, which reduces the risks of commercial lending or grant finance. Thus, carbon finance provides a means of leveraging new private and public investment to projects that reduce GHG emissions, thereby mitigating climate change while contributing to sustainable development.

During the entire Bonn commitment period of fiscal 2005–09, the Carbon Finance Unit committed US$380 million for energy efficiency and renewable energy projects. In fiscal 2009, the Carbon Finance Unit committed US$29 million for energy efficiency and renewable energy projects in East Asia and the Pacific, South Asia, and Sub-Saharan Africa. Projects such as the US$15 million Thailand Bioenergy Sugar Ethanol Wastewater Management Project generate energy from the waste ethanol resulting from sugar production. In cooperation with the GEF and the Multilateral Fund for the Implementation of the Montreal Protocol, the Carbon Finance Unit

also helped finance a landmark project in India. This project, now being replicated in other client countries, sought to increase the efficiency of chillers in India, decreasing demand for energy and reducing emissions of ozone-destroying CFCs.

Case Study 6:
Beijing Tackles Waste…and Helps the Environment with MIGA Guarantees

The Chinese government has placed an increasing priority on tackling GHG emissions, because while rapid development in China has fueled economic and urban growth, it has not come without costs to the environment. A large source of pollution is household waste. Landfills that treat waste produce methane, a primary GHG, estimated to be 21 times more harmful than carbon dioxide. That is why China is encouraging landfills to capture methane, although local communities often lack the capacity to do so. At the same time, the global energy squeeze is prompting officials to consider new ways of generating electricity.

Converting Waste to Energy

As part of this effort, the city of Beijing aims to convert 40 percent of its waste into energy by 2010, with four waste-to-energy treatment plants slated for construction in order to achieve this target. MIGA helped secure financing for the first plant with US$25 million in investment insurance for Golden State Waste Management Corporation.

Beijing accounts for some 11,000 tons of trash a day, 60–70 percent of which goes into methane-emitting landfills. "This project is sending 1,600 tons of garbage from Chaoyang District to the incinerator to generate electricity," said Lawrence Shi, Vice President of Golden State Waste Management Corporation. "This will reduce pollution to the environment and to underground water, as well as help save the land that is used for landfills."

As Beijing's first incineration plant, the investment is serving as a model for other waste treatment projects planned by the government. "This project is key for Beijing during the Olympics, but it's also important

"China also has an ambitious program to develop renewable energy sources and to increase their role in the overall energy mix." David Dollar, former World Bank Country Director for China

The city of Beijing is planning to build four waste-to-energy treatment plants by 2010. MIGA is supporting the first of the four plants.

to meet our long-term environmental goals," said Xu Jin Xin, Director of Chaoyang District Administrative Committee. "It's also very necessary because right now there is no waste management, and it is through the incineration process that we convert waste into a resource and help improve the environment. Another benefit is that the power plant is turning waste into a resource to provide people with electricity."

"Although the main goal of the project is to manage waste, rather than generating power, the electricity produced by the plant can supplement power generated by coal and fossil fuels," Shi added.

MIGA Helps Investors Overcome Risks

MIGA's political risk insurance helps mitigate the risks that typically affect infrastructure projects, such as breaches in contract. MIGA's work is helping developing countries onto a lower-carbon path by exploiting renewable energy resources, supporting energy conservation, and increasing efficiency.

"Addressing climate change is central to the World Bank Group's development and poverty reduction agenda," said Moina Varkie, former Director of External Outreach and Partners in MIGA. "We are pleased to be associated with a project that not only reduces carbon emissions, but also helps to conserve scarce landfill capacity in the face of burgeoning urban growth—while generating electricity from a renewable resource. This is truly a win-win-win situation."

"The biggest plus from MIGA is the confidence MIGA's insurance gives to investors, especially international investors," according to Charles Shen, Deputy Financial Controller with GSE Investment Corporation. "We know that political risk is not an issue for us since we have been in this market for 20 years. But for international investors, they don't have such knowledge, such experience."

Case Study 7:
Liberia's Better Light Solar Project: A Model for Scale

The AFREA-supported Catalyzing New Renewable Energy in Rural Liberia Program and the Lighting Africa Program are building on grassroots developments, such as the taa bora *lanterns, to expand the widespread availability of low-cost, high-efficiency, and environmentally friendly lighting solutions as alternatives to kerosene lights and candles.*

In September 2009, the King Gray Public Elementary School in Paynesville, Liberia, took part in a lighting experiment that introduced a new, innovative, and low-cost solar lighting solution to Liberia's schools that allows for expanded evening education classes for youth and adults, and replaces the use of costly diesel fuel. The lighting system was assembled locally by a women's enterprise group and installed by a local solar engineer.

The school system is based on a small light called the *taa bora*—"better light" in Swahili—that was invented by a United States–based entrepreneur after a visit to rural Tanzania in 2003. His aim was to create a modern, environmentally friendly lighting solution that would replace candles and kerosene, cost less, last considerably longer, and could be assembled by local villagers. The result—a portable light that with a simple adjustment becomes a desk lamp for studying—is made up of a recycled plastic water bottle, rechargeable AA batteries, LED bulbs, and simple electronic components that are assembled without the need for electricity. The light lasts a minimum of three years and is charged by a 1.5-watt solar panel.

The genius of the *taa bora* is that it is both high-technology and grassroots in nature—it is an indigenous commodity. It represents the bottom rung of the energy ladder and was intended for people whose primary energy need is light. Needs will change over time as conditions improve, so the *taa bora* can also be modified into a simple home lighting system using the same basic components.

The school lighting system installed in Paynesville takes the *taa bora* to a larger scale. It uses a series of connected 1.5-watt solar panels to increase capacity, has larger batteries, and requires more sophisticated engineering. Nonetheless, this system's costs are only about a tenth of a traditional solar system, which makes it affordable to school associations and communities and frees it from dependence on donor funding.

The *taa bora* was introduced to Liberia as a portable light and desk lamp in November 2008. Five enterprises were set up around the country with staff trained both to assemble the light and install the simple home system. One group, the Charity Prayer Band in Paynesville—a prayer, empowerment, and *susu* (savings and loan) club made up of 50 women—far outshone the rest. Their sales were consistent, marketing was enthusiastic, and quality of work was high. They were the obvious choice for partnership when a group of international and local organizations came together with the *taa bora* inventor and decided to re-imagine the *taa bora* for application in Liberia's schools.

Simultaneous with installation of the school lighting system, a new enterprise group from the King Gray community was established, with members trained in the assembly and sale of the *taa bora* portable lights, as well as upkeep of the school lighting systems. A *taa bora* rental program was initiated at the school; small rental fees pay for upkeep of the school lighting system. In that way, the school and enterprise will together be able to sustain the project long after the original funding is exhausted.

Although the project is still in its early stages, the principal of the school has already noticed some results. The school offers accelerated learning classes, where grades 1–6 are taught to older youth and adults who missed out on education during Liberia's civil war or because—in the case of women—they were kept home by chores or children. Prior to installation of the lighting system, enrollment in these classes was low because of timing constraints; they could only be offered in the afternoon while the sun was still up. Now modern lighting allows for evening classes, meaning that adults can come at the end of their work days. Currently, a large number of students fill four classrooms. The principal notes that enrollment has particularly increased among women, who now make up the majority of the classes.

Evening adult education classes by the light of the school system developed from the taa bora *concept.*

A taa bora *made from a recycled plastic water bottle, rechargeable AA batteries, and an LED bulb. With a slight modification, it doubles as a desk lamp for studying.*

The Paynesville-based Charity Prayer Band women's enterprise assembling taa boras

Chapter 4: Looking Forward

The World Bank Group's Past Efforts to Expand the Renewable Energy and Energy Efficiency Portfolio

The World Bank Group has rapidly expanded its support for renewable energy and energy efficiency in order to promote sustainable and low-carbon energy development. In addition to contributing to GHG mitigation, application of these clean energy technologies has helped advance the development goals of World Bank Group client countries by reducing oil imports and total energy costs and improving economic competitiveness. The World Bank Group has also been able to respond quickly to its clients' growing demand, partly driven by the volatility of oil and other conventional energy prices, concerns about reliable access to adequate energy supplies, greater concern about climate change, and cost reductions and technology maturation in renewable energy and energy efficiency.

Technology development and financing will be critical to scale up the share of renewable energy and energy efficiency investments in the global energy portfolio. Recognizing the multi-dimensional development benefits of promoting renewable energy and energy efficiency, all three agencies of the World Bank Group—the World Bank (IBRD and IDA), IFC, and MIGA—have, in addition to augmenting their low-carbon investments, employed a host of related policy, regulatory, technical, financial, and risk mitigation tools to enhance incentives for client countries. The World Bank Group acknowledges that advancements and innovations in renewable energy and energy efficiency need to go hand in hand with effective planning, transparent decision-making mechanisms, suitable business and regulatory environments, and successful commercialization in order to fully take advantage of the unique characteristics of these technologies, especially the wealth of development benefits they can bring. Many of these issues must be addressed locally, consistent with market conditions, resource availability, and policy environment difference. The IFC is also expanding backwards into the renewable energy supply chain (see Box 8).

Box 8: IFC Investments in the Manufacture of Renewable Energy Technology

As the global renewable energy market has become larger and more mature in recent years, commercial investment opportunities have also expanded rapidly. Adding to its portfolio of investments in wind, biomass, geothermal, and small hydro for power generation, the IFC has invested in the manufacture of renewable energy materials and equipment, based partly on opportunities for export to policy-based markets in industrial countries, but also in the interest of creating a base for domestic expansion. The large demand within OECD markets has been beneficial insofar as it has allowed greater investment and economies of scale. However, supply bottlenecks and shortages have kept prices high with adverse effects. The IFC is now extending the scope of its clean energy interests with an allocation of resources for early-stage clean technology investments, bringing new risks and opportunities for accelerating market development.

Global Challenges for Scaling Up Renewable Energy and Energy Efficiency

Much of the world has yet to realize the full potential and transformative promise of renewable energy and energy efficiency. At the global level, energy-related GHG emissions account for about 70 percent of total emissions and are projected to grow by about 50 percent by 2030 unless supportive and effective policy measures are introduced very soon. Meeting developmental goals while stabilizing GHG emissions will require massive investments in renewable energy and energy efficiency. As studies by the International Energy Agency (IEA), IPCC, McKinsey[27] and other sources have indicated, in order to limit GHG emissions to 450 ppm by 2030, energy efficiency and renewable energy measures (including biofuels) will have to contribute 54 percent and 23 percent of potential GHG reductions, respectively.[28] While these clean energy options are cost-effective compared to traditional supply-based measures in the longer term and on a lifecycle cost basis, they will require additional upfront investments of US$9,300 billion during the period 2010–30, including US$5.7 trillion for energy efficiency measures, according to the IEA. If cost-saving efficiency measures are neglected or delayed, the effective cost for emissions reductions increases many times over. Although finding financing to manage the investment costs will be daunting, in many cases the more challenging task is creating a receptive market and policy environment.

The World Bank Group's Continued Commitment into the Future: SFDCC and Energy Strategy

During the past two years, the World Bank Group launched several initiatives building on its continued and expanded support for renewable energy and energy efficiency. The 2008 Board-approved paper, *Development and Climate Change: A Strategic Framework for the World Bank Group* (SFDCC), serves to guide and support the operational response of the World Bank Group to new development challenges posed by global climate change. Some of the major initiatives have been embedded within the SFDCC to grow our clean energy portfolio more proactively, with emphasis on attaining more ambitious goals. Under the SFDCC, the World Bank Group will increase financing for energy efficiency and new renewable energy by an average of 30 percent a year, from a baseline of US$600 million, and expand lending to hydropower, with the share of low-carbon projects (new renewable energy, energy efficiency, and hydropower) rising from 40 percent in fiscal 2006–08 to 50 percent in fiscal 2011. This commitment comes on the heels of, and as a logical extension of, the attainment of the World Bank Group renewable energy and energy efficiency 2004 Bonn commitment. The full impact of this lending goes well beyond the direct amount of loans provided, since the market impact is typically many times larger.

The World Bank's Energy Strategy[29] (under preparation) will provide a framework to achieve the twin objectives of (a) improving access to and reliability of energy supply, and (b) facilitating the shift to a more environmentally sustainable

[27] The *World Development Report 2009* (Washington, D.C.: World Bank), chapter 4, and the IEA *World Energy Outlook 2009* (Paris: IEA, 2009), to be released November 10 (highlights released the week of October 13–16, 2009, at the Bangkok UNFCCC meeting).

[28] According to IEA analysis, taking into account the economic downturn and some recent announcements of climate policy commitments, the global energy system is roughly on track to stay within a target of 550 ppm, but substantial additional policies and shifts in investment will be required to reduce emissions sufficiently to stay within 450 ppm (IEA, *World Energy Outlook 2009* (Paris: IEA, 2009)). However, there is increasing concern that even this target will not be adequate to avoid dangerous climate changes and that more aggressive reduction goals may be required.

[29] See the World Bank Energy Strategy Consultation at http://www.worldbank.org/energyconsultations

energy development path. This strategy will be informed by extensive global consultations with all stakeholders, promote complementary roles of the public and private sectors, facilitate the use of innovative financial products and technical assistance, and provide renewed attention to incentives for energy efficiency and renewable energy, as well as subsidy and pricing issues.

Going forward, the World Bank Group will continue to leverage its technical expertise, policy advice, and financing resources to further catalyze and mainstream renewable energy and energy efficiency applications by the public and private sectors in its client countries. To achieve the new, ambitious goals under the SFDCC, a multi-track approach will be adopted across the World Bank Group.

Strategically identify renewable energy and energy efficiency opportunities and expand portfolio. The World Bank Group will identify new opportunities across all sectors (through methods such as the screening of all upcoming energy projects to identify feasible energy efficiency opportunities); provide support for low-carbon growth country studies (see Box 9); promote energy efficiency across other sectors (including urban and transport) through the Energy Efficient Cities initiative of ESMAP; and engage clients during early stages (for example, the Country Assistance Strategy stage) on renewable energy and energy efficiency support prospects. See Case Study 8 for an example from Thailand.

The IFC adopted a similar approach a few years ago to identify, promote, and finance energy efficiency and other cleaner production opportunities (for example, water and materials efficiency) in its investments portfolio. A new facility has been created at the IFC with US$120 million, with the objective of streamlining processing for cleaner production audits, technical support, and associated financing.

On the technologies front, ongoing activities include disseminating knowledge for key emerging technologies (such as carbon capture and storage, concentrating solar power, and smart grids); working with GEF on acceleration of pre-commercial clean energy technologies for developing countries; and contributing to United Nations Development Programme (UNDP) efforts regarding technology needs assessments. The IFC/GEF Earth Fund, with an initial commitment of US$60 million, is promoting private sector–based clean technology and solar projects. As these technologies become increasingly commercial, the IFC is committing resources from its own balance sheet to both direct investments and early-stage "clean tech" funds in developing countries.

Mobilizing Additional Resources for Renewable Energy and Energy Efficiency

To reduce the financing resource gap in addressing the challenge of scaling up renewable energy and energy efficiency, the World Bank Group's own funds will be complemented by new concessional resources, in addition to the GEF and carbon market finance. The Climate Investment Funds (CIF) are a new source of financing for pilot projects to initiate transformational change toward low-carbon and climate-resilient development. The CIF funds, to be disbursed as grants, highly concessional loans, and/or risk mitigation instruments, are administered through the multilateral regional development banks and the World Bank Group for quick and flexible implementation of country-led programs and investments. CIF consists of the **Clean Technology Fund** with donor commitments of US$5.2 billion, and the **Strategic Climate Fund** (SCF). The Clean Technology Fund promotes scaled-up demonstration, deployment, and transfer of low-carbon technologies in the power and transport sectors, as well as energy efficiency in buildings, industry, and agriculture. Explicit provision has been made for private sector participation as part

Box 9: Low-Carbon Growth Country Studies Program

Studies in China, India, Indonesia, Mexico, Poland, and South Africa have reinforced some broad messages (for example, the need for renewable energy and energy efficiency support) and also returned some surprises (for example, low-cost transport options and cogeneration investments). As a global public good, the wealth of knowledge generated by these efforts is being used to develop strategies and direct GHG reduction investments being pursued in the Clean Technology Fund program. Among other things, the studies have engendered in-country ownership of mitigation strategies and provided two extremely valuable outputs: (a) a process for establishing low-carbon strategies; and (b) a growing, useful knowledge and data set that can be used both to help other countries reduce their GHG emissions and to decrease the cost of mitigation. The work currently underway is constructing models for low-carbon development strategies in emerging economies. Some highlights are as follows:

- **Mexico's study** provides a body of knowledge about prospective low-carbon "wedges," specific low-carbon projects, and the continuing policy reform agenda. The primary energy savings identified arise from cogeneration and energy efficiency improvements in industry. Also, the forestry sector has untapped mitigation potential.
- **Brazil's** Low Carbon Study focuses on new models for land use, land use change, forestry, and energy planning. The detailed sector methodologies are already in use, yielding useful technical results which will potentially be incorporated into new investment programs. The study has enhanced linkages between technical research groups and corresponding government ministries and agencies relevant to climate change, increasing useful information exchange.
- **South Africa's** study is helping to create an environment for implementing energy efficiency and DSM.
- **India's** study reveals that the country has a relatively low-carbon economy. The priority remains to meet energy demand and sustain high economic growth despite energy shortages, problems with access, and poverty concerns.
- The **Indonesian** study provides insight into fiscal and financial policy instruments—as well as tax and spending policies—used to promote movement toward a lower-carbon economy, to consider strategic investment approaches and financing sources, and to improve fiscal incentives in forestry.
- **China's** study provides policy support to understand renewable energy and energy efficiency targets and low-carbon growth better.

For more details, see *Low Carbon Growth Country Studies—Getting Started: Experience from Six Countries*, ESMAP 2009.

of an overall emphasis on market transformation. Three projects were approved for Clean Technology Fund funding in fiscal 2009 by the CIF Trust Fund Committee for Egypt, Mexico, and Turkey. The Turkey project was approved by the World Bank board in May 2009.

One of the proposed SCF funds, **Scaling Up Renewable Energy in Low-Income Countries**, is under development. Targeted at low-income countries, this US$250 million fund will assist low-income countries transition to low-carbon development paths, primarily through the expanded use of renewable energy and energy efficiency.

Recognizing that infrastructure investments and maintenance were the main casualties during and after the Asian financial crisis of the late 1990s and other similar recessions, the World Bank Group has launched the **Infrastructure Recovery and Assets (INFRA)** platform to prevent a similar outcome after this recession. From this platform, staff will lead

and coordinate the World Bank Group's efforts to enhance investments in ongoing projects that are at risk of losing their financing, as well as in projects near closure whose financing has collapsed. INFRA will also provide dedicated resources to maintain the current infrastructure spending for new assets and regular maintenance of assets, investments that garner higher returns than end-of-term renovation or rehabilitation.

CIF and other facilities will complement the existing GEF support at the global level, which has already helped countries make US$8 billion investments in more than 2,000 environmental projects over the last 18 years, including many in the area of renewable energy and energy efficiency. Through a programmatic approach, the CIF's, GEF's, and World Bank Group's funds will be combined with carbon finance through the Clean Development Mechanism (CDM) and any future carbon emissions mitigation mechanisms whenever possible.

The establishment of two new carbon facilities in the World Bank—the Carbon Partnership Facility and the Forest Carbon Partnership Facility—marks a new phase for the World Bank's carbon finance business. The move reflects the World Bank's growing focus on scaling up climate change mitigation work and deepening and broadening the carbon market beyond the current 11 carbon funds and facilities, which have a total capital value of more than US$2 billion. This work also reflects the important role of the World Bank Group in addressing methodological issues and measurement and verification barriers to expanding the carbon market to include more programmatic approaches in the land use and forestry sectors. The IFC is increasingly seeking to incorporate carbon finance as a source of added value whenever relevant to

The WBG/GEF-financed Al-Kureimat solar thermal power plant in Egypt, under construction, March 2009.

Uzbekistan

its investments, and in so doing is promoting greater awareness of climate change risks and opportunities among its clients. In addition, the IFC helps companies get more value for their carbon credits by offering two financial services not readily available in the market: a Carbon Delivery Guarantee to buyers of Kyoto credits in developed countries, and the option of structuring loans against future revenues from such credits.

Going forward, a critical question will be the outcome of ongoing international climate negotiations, especially the convention in Copenhagen in December 2009. Two of four "pillars" discussed in these negotiations are technology and financing. While the institutional arrangements, use of funds, and new donor commitments are still to be agreed, there is a strong expectation that support for accelerating clean energy investment in developing countries will be a major objective.

Support enhanced capacity for clean energy in client countries. The climate convention and GEF have identified increased institutional capacity and a supportive enabling environment as critical requirements for successful technology transfer. The World Bank Group supports this objective through projects that focus on the development of good energy policies. Recently, the World Bank Group, as host of the InfoDev program, together with the U.K. Carbon Trust and the U.K. Department for International Development (DFID), established a support program for Climate Technology Innovation Centers. In projects such as Lighting Africa, the World Bank Group also promotes favorable market environments through quality assurance, consumer awareness, knowledge creation and

Tunisia

dissemination, and product testing in order to catalyze the introduction of advanced electric lighting technologies to African populations currently dependent on fuel-based lighting.

Incentivize and build staff capacities and capabilities. The World Bank Group intends to continue with specialized staff recruitment, including a Senior Advisor for Renewable Energy and Energy Efficiency to the Sustainable Development Network at the World Bank. The development of operational tools (such as the REToolkit, PV for community service applications, and the Energy Efficient Lighting Toolkit), advanced technology assessments, provision of institutional development and capacity building for various stakeholders, and targeted knowledge products (such as those relating to carbon capture and storage, energy efficiency, and concentrating solar power) are building a foundation on which to base efforts to scale up the World Bank Group's clean energy investments. The Energy Strategy process will consider additional ways to enhance the role of the World Bank Group as a source of both technical information and policy advice supporting clean energy.

Establish robust monitoring and reporting mechanisms. Many new lessons are emerging from among the projects in the World Bank Group's clean energy portfolio. As clean energy continues to grow as a share of the World Bank Group's overall energy investments, the quality of associated projects will improve as they build on past lessons learned. The World Bank Group also acknowledges that it is important to step back and do an adequate assessment of each country's present infrastructure and environment in order to understand what best

practices are applicable, as well as which approaches could be adapted and incorporated into broader strategies as World Bank Group client countries move onto low-carbon development paths. The World Bank Group is preparing systems and guidelines for better monitoring and reporting of outcomes and impacts from its energy investments.

Expand engagement with external partners. The World Bank Group continues to engage with other global and regional stakeholders, such as the United Nations, IEA, REN21, REEEP, Forum of Energy Ministers of Africa (FEMA), private sector actors, and the newly established International Renewable Energy Agency (IRENA), as a collective and coordinated effort is needed at all levels. With 1.6 billion people still without access to electricity—and an equal number dependent on traditional inefficient and polluting use of biomass fuels for heating and cooking—there remains much to be done to improve access to modern energy. The UNFCCC and the Bali Action Plan emphasized the responsibility of developed countries not only to reduce their own emissions, but also to assist developing countries with necessary and appropriate investments to reduce the growth in their GHG emissions. The negotiations leading to the Copenhagen climate meetings in December 2009 focus on both finance and technology for clean energy technologies, and will have important implications for the World Bank Group.

Helping the World Move toward a Cleaner Energy Future

For many reasons—energy resource costs, climate change and other environmental constraints, and health and other social issues—the global energy system must undergo a radical transformation in the near future. On the one hand, growing development energy needs must be met in order to usher billions of people onto the path of economic development. On the other hand, climate change policies and actions must be integrated into this development plan. Renewable energy and energy efficiency have long been pursued as important policy tools in addressing vulnerability to volatile oil prices, to enhancing the security of energy supplies, avoiding the use of traditional supply options that are dependent on long supply chains, and cost-effectively reducing energy and power shortages as global energy demand has rapidly grown. At the same time, adopting these measures can also contribute to mitigating the global growth of GHG emissions. Thus, from an energy sector development perspective, it is imperative that the significant potential for expanding renewable energy and energy efficiency projects in developing countries be exploited at a rapid pace. Massive investments in this sector should be made, with supportive policy and regulatory measures introduced, especially in developing countries.

In partnership with other agencies, the World Bank Group has already been building on synergies between climate action and development, working on energy security and energy efficiency, and promoting renewable energy in our client countries. The World Bank Group has far surpassed the commitment it made at the Bonn International Renewable Energies Conference in 2004. This rapid expansion in support for renewable energy and energy efficiency has been driven by the increased priority given to the sector by the World Bank Group, as well as by the favorable response from developing countries and reinforcing trends in energy markets and technology.

The momentum for promoting low-carbon growth in the World Bank Group's client countries, which has increased over the last several years, is expected to continue growing in the future under the SFDCC framework and the forthcoming World Bank Group Energy Strat-

egy. The effective synergies between DCSSF, the Energy Strategy, and emerging World Bank Group programmatic innovations supported by the GEF, CIF, and carbon markets will continue to facilitate the increase in renewable energy and energy efficiency investments by addressing the critical interdependence of climate change and development. These new initiatives will provide strategic coherence and enhance the operational impact of the World Bank Group's renewable energy and energy efficiency activities, and uphold the institution's role as an enabler of global dialogue on shifting energy development to a cleaner, more sustainable pathway.

Case Study 8:
Making Transport More Energy-Efficient in Thailand

The *Thailand Country Development Partnership in Infrastructure* study addresses the question of how Thailand's transport sector can become more energy efficient. It assesses the performance of the transport sector in energy utilization, analyzes where inefficiencies lie, and proposes options to improve sector energy efficiency.

Improved energy efficiency is imperative for Thailand's national energy security and continued economic prosperity. Historically, Thailand has not performed well in terms of energy efficiency. Total energy intensity, defined as total final energy consumption per unit of gross domestic product (GDP), is high compared to other countries and at least twice that of Germany, Japan, and the United States. Moreover, Thailand's total energy intensity has remained more or less the same over the past three decades, in sharp contrast to many other countries that have reduced their energy intensity over the same period. This implies that Thailand has great potential to achieve lower energy intensity.

At present, two sectors—*manufacturing and mining* and *transport*—account for 70 percent of total energy use in Thailand, with each constituting approximately an equal share. Petroleum products account for half of total final energy consumption in Thailand. Seventy-two percent of petroleum products are used in the transport sector, which derives almost all its energy from this source. The road sector consumes seventy-six percent of transport energy. With little fuel diversification and only a small amount of energy coming from renewable sources, the security of Thailand's energy supply is highly vulnerable to possible future fossil fuel supply constraints or rapid price increases.

The study found that the economic structure and spatial distribution of economic activities in Thailand do not impose extraordinary requirements on transport. Other factors—mainly the high level of motorization, heavy dependence on road transport, and lack of fuel economy standards—contribute to the high level of transport energy intensity. Road transport overwhelmingly dominates freight and passenger transport markets, while rail plays a very small and declining role. The majority of Thailand's vehicles use diesel, and fuel economy standards are not applied to gasoline- or diesel-powered vehicles. The truck fleet is on average quite old and fuel-inefficient. Because of low taxes, fuel prices are relatively low compared to those in Japan and Western European countries. The estimated fuel efficiency of Thailand's passenger vehicle fleet today is approximately 25–30 percent lower than the levels found in Japan and Western Europe. Traffic congestion in the Bangkok Metropolitan Region (BMR) also contributes significantly to Thailand's high transport energy intensity.

As a policy option, pricing fuels on the basis of their long-run marginal costs is expected to have a significant and sustained effect on the improvement of transport energy efficiency in Thailand. However, recognizing the political difficulties in implementing a comprehensive fuel pricing policy in the short to medium term, the study also examined 16 other policy and technology options. These are grouped into the following five categories:

1. **Fuel efficiency and fuel switching.** Upgrade engine technologies for buses and trucks, and use natural gas selectively in vehicle fleets, especially commercial vehicles.
2. **Better vehicle standards.** Establish and progressively raise the fuel economy standards of passenger vehicles to match European standards, and improve logistical practices in the

road-based freight transport sector, better matching truck sizes to their tasks and operating environments.

3. **Rail investment and reform.** Reform and modernize the rail sector, expand the role of rail in freight transport and long-distance passenger services, expand mass rail transit and improve its integration with bus services, and improve the accessibility and walkability of bus stops and mass rapid transit stations.
4. **Better urban bus services.** Increase the speed and quality of bus services through expansion of bus rapid transit and investment in a new fleet, which will bring improved passenger comfort, better fuel efficiency, and lower emissions.
5. **Policy and pricing measures.** Upgrade the vehicle registration system and associated charges that reflect actual vehicle use, improve traffic management, and promote more efficient bus services through reforms that encourage competition and new investment.

These options are essential elements in any efficient transport sector strategy. Most of them are win-win options in both transport performance and energy efficiency. A simple quantitative assessment of these options indicates that if all options are successfully implemented in Thailand, about one-third of the total annual transport energy use can be reduced in 2025 compared to the "business as usual" scenario. The savings would be more substantial if a comprehensive fuel pricing policy is also enacted.

Implementing the above options requires strong commitment and serious effort on the part of the government, especially in overcoming political and institutional impediments that protect the status quo. Thailand's own success in phasing out leaded gasoline and improving Bangkok's air quality in the 1990s provides many relevant lessons for application to the implementation of the transport energy efficiency agenda.

Annex 1: Institutional Support for Renewable Energy and Energy Efficiency

This annex describes the various World Bank Group institutions and units, as well as the role that each plays in contributing to renewable energy and energy efficiency. It also provides definitions of renewable energy and energy efficiency. Last, it discusses the methodology used to compute the data in this report.

Roles of the Institutions

The World Bank Group

In this report, the World Bank Group refers to four closely associated World Bank institutions that directly support renewable energy and energy efficiency activities: the IBRD, IDA, IFC, and MIGA. There are six operational regions under the IBRD and IDA. The report disaggregates the commitments made by these regions and institutions. In addition, the World Bank Group is an implementing agency for the GEF. This report provides information on GEF projects administered by the World Bank. The World Bank Group's Carbon Finance Business is reported separately because it is a unique business line that purchases emissions reductions and does not directly invest in projects.

The IBRD

The IBRD (International Bank for Reconstruction and Development) aims to reduce poverty in middle-income and creditworthy poorer countries by promoting sustainable development through loans and guarantees and, in the nonlending area, analytical and advisory activities (AAAs; *http://www.worldbank.org/ibrd*).

IDA

Contributions to IDA (International Development Association) enable the World Bank to provide approximately US$6–9 billion a year in highly concessional financing to the world's 80 poorest countries (home to 2.5 billion people). IDA's interest-free credits and grants are vital because these countries have little or no capacity to borrow on market terms (*http://www.worldbank.org/ida*).

IFC

The IFC's (International Finance Corporation's) mandate is to further economic development through the private sector. Working with business partners, it invests in private enterprises in developing countries and provides long-term loans, guarantees, and risk management and advisory services to its clients (*http://www.ifc.org*).

MIGA

MIGA (Multilateral Investment Guarantee Agency) provides political risk insurance against noncommercial risks to eligible foreign investors and commercial banks for qualified investments in developing member countries (*http://www.miga.org*).

Carbon Finance

Both the IBRD and IFC have Carbon Finance Units that leverage public and private investment for projects that reduce GHG emissions. This helps to grow the market by extending carbon finance to both developing and transitional economies. The funds are provided by

private companies and governments seeking to purchase emissions reductions to learn how to initiate transactions in this complex emerging market. The Carbon Finance Business (CFB-IBRD) is divided into separate business lines—the IBRD CFU (*http://carbonfinance.org/*) and IFC CFU (*http://www.ifc.org/carbonfinance*).

ESMAP

ESMAP (Energy Sector Management Assistance Program) is a global technical assistance program and knowledge partnership sponsored by a group of donors, including Canada, Denmark, Finland, Germany, the Netherlands, Norway, Sweden, the United Kingdom, the United Nations Foundation, the United Nations Development Programme, and the World Bank. ESMAP is managed by the World Bank (*http://www.worldbank.org/esmap*).

ASTAE

In 1992, the World Bank and donor partners established ASTAE (Asia Sustainable and Alternative Energy Program) to support the transition to environmentally sustainable energy use in developing countries in Asia. ASTAE supports upstream economic and sector work, much like ESMAP, and also provides assistance in the identification, preparation, and supervision of renewable energy and energy efficiency projects (*http://www.worldbank.org/astae/*).

The GEF

The Global Environment Facility (GEF), established in 1991, helps developing countries fund projects and programs that protect the global environment. GEF grants support projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and persistent organic pollutants. GEF is an independent financial organization that provides grants to developing countries for projects that benefit the global environment and promote sustainable livelihoods in local communities. The GEF is the World Bank Group's largest partner in the area of renewable energy and energy efficiency investments (*http://www.thegef.org*).

Definitions

Following are the definitions used for reporting on the World Bank Group's activities. Commitment amounts used in the report were prorated to include only those project components that clearly fall into one of the following categories.

New Renewable Energy

Projects or project components were classified as new renewable energy if support was provided for solar energy for heat or power, wind energy for mechanical or electrical power generation, geothermal or biomass energy for power generation or heat, hydropower of 10 MW or less per installation, and waste-to-energy operations, if they generate electrical power or heat for productive uses.

Energy Efficiency

Energy efficiency covers both demand-side efficiency and supply-side efficiency components.

- **Demand-side efficiency** includes improvements in efficiency resulting from load management, demand response programs, and direct load control; improvements in end-use energy efficiency in the residential, commercial, industrial, public-municipal, agricultural, and transport sectors; and energy conservation. Also included are energy efficiency improvements through institutional development, regulatory reforms, and improvements in utility management performance; introduction of improved building codes, appliance energy efficiency standards, and labeling systems; retrofits to

meet new standards; energy audits; waste heat recovery; improved fuel-efficiency standards for automobiles; use of drip irrigation or irrigation pumping in agricultural systems; municipal water pumping; energy efficiency financing through financial intermediaries; and implementation of consumer awareness programs.

- **Supply-side energy efficiency** encompasses transport systems (including modal shifts from cars to mass transit systems); district heating enhancements; improved power transmission and distribution, including enhanced metering systems, capacitors, and substation rehabilitation; power system optimization; plant rehabilitation (including plants that offset conventional fuels and the installation of supercritical boilers); improved operation and maintenance; and combined heat and power plants.

The projects or project components for energy efficiency include investments in rehabilitation of transmission and/or distribution networks only when the share of energy efficiency improvements in such projects can be clearly disaggregated from other objectives, such as network expansion and load increase. Interventions in Development Policy Loan commitments are included only when the share attributable to energy efficiency can be clearly demarcated.

Hydropower Greater Than 10 MW

The World Bank considers hydropower, regardless of scale, to be renewable energy. However, for reporting purposes, hydropower projects in which the installed capacity at a single facility exceeds 10 MW are listed separately.

The World Bank Group supports projects that may be cross-sectoral in nature. For example, renewable energy and energy efficiency components may be embedded within an agricultural, health, or power project. In such blended projects, sometimes it is not easy to specify precisely what the size of each sectoral component is. In this report, as far as possible, great care has been taken to show only the commitment amount associated with new renewables, energy efficiency, or hydropower greater than 10 MW. For example, in a particular project, the total commitment made by the IBRD and IDA may be US$100 million. This project may have three different sectoral components: agro-industry, 50 percent; health, 30 percent; and new renewables, 20 percent. In such a case, only US$20 million has been included as the project's contribution to renewable energy.

Different Reporting Styles

The various World Bank institutions have differing styles of reporting their data because of their different modes of business. For example, MIGA provides guarantees to projects against various kinds of risks, whereas the IBRD and IDA provide project finance and guarantees. Purchases of emissions reductions through carbon finance are a revenue stream. The IFC provides both equity and loan financing, as well as guarantees. For the purposes of this report, and to arrive at an estimate of the World Bank Group's total commitments toward renewable energy and energy efficiency, we have added commitments made by each World Bank Group institution. The following distinctions should be kept in mind when reading this report.

The IBRD and IDA

For IBRD- and IDA-assisted projects, commitment amounts toward renewable energy, energy efficiency, or both for each project have been used to estimate the cumulative total for the World Bank Group. Only those project components that could clearly be attributed to a renewable energy and energy efficiency category were counted.

IFC

The report shows IFC net investments from its own account for renewable energy and energy efficiency investment. Previous IFC assessments referred only to stand-alone projects whose sole focus was energy efficiency or renewable energy, thus missing the full scope of investment in sustainable energy undertaken as a component of larger investments in various sectors. The IFC has since revised its methodology so that it now identifies renewable energy and energy efficiency investments in commitments it has made in other sectors, such as agriculture, water supply, industry, and transport, and in corporate loans to financial intermediaries. The methodology assesses the percentage of IFC investment in proportion to the full project cost and applies that proportion to the full renewable energy or energy efficiency project value. This methodology has been used to update the IFC's renewable energy and energy efficiency commitment amounts since fiscal 2005. For more details, see *Choices Matter: 2005 Sustainability Report* (Washington, D.C.: IFC, 2006) at *www.ifc.org/SustainabilityReport*.

MIGA

MIGA reports the maximum liability of its guarantee and the foreign direct investment that the guarantee has leveraged. For the purposes of arriving at a cumulative total for the World Bank Group, this report added together only the MIGA maximum liability.

Carbon Finance

For purposes of this report, to compare carbon asset purchases and regular project financing, this report considered signed Emission Reductions Purchase Agreements to be the appropriate measure and added those amounts to arrive at the total commitment—that is, the Carbon Finance Business equivalent of board approval for World Bank loans.

The GEF

For approved GEF projects, this report uses the commitment amounts for each project.

Annex 2: Annual Renewable Energy and Energy Efficiency Commitments from Fiscal 1990 to Fiscal 2009

Annual Table 1: WBG Renewable Energy and Energy Efficiency Commitments (US $ millions)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
New Renewables	53	2	56	227	300	59	47	336	15	239	444	26	169	206	138	246	344	421	473	1,427	5,227
Energy Efficiency	—	265	54	10	59	148	380	56	356	26	295	193	67	177	92	217	761	262	1,192	1,701	6,307
Hydropower (greater than 10 MW)	—	150	161	938	186	317	819	15	461	—	320	—	181	23	83	538	250	751	1,007	177	6,376
Grand Total	53	417	271	1,174	545	524	1,245	407	832	264	1,059	219	416	406	313	1,001	1,355	1,433	2,672	3,305	17,911

Annual Table 2: WBG Renewable Energy and Energy Efficiency Commitments (US $ millions) by Institution or Unit

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
GEF	—	—	3	36	56	35	10	78	28	56	111	14	37	55	46	100	51	128	145	83	1,073
GEF-IFC/TF	—	—	—	—	—	—	37	33	—	30	5	—	19	28	1	1	—	—	4	—	156
IBRD Carbon Finance	—	—	—	—	—	—	—	—	—	—	—	2	8	10	21	39	40	144	126	29	419
IBRD/IDA	53	392	196	1,113	303	452	1,108	146	534	137	691	197	340	200	245	506	756	549	1,340	2,157	11,413
IFC	—	25	72	26	186	7	36	135	206	15	1	6	13	113	—	255	492	450	906	1,036	3,978
IFC Carbon Finance	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	13	7	39	—	69
MIGA	—	—	—	—	—	30	35	15	65	26	252	—	—	—	—	91	2	155	110	—	780
Special Financing	—	—	—	—	—	—	20	—	—	—	—	—	—	—	—	—	—	—	3	—	23
Total Commitment	53	417	271	1,174	545	524	1,245	407	832	264	1,059	219	416	406	313	1,001	1,355	1,433	2,672	3,305	17,911

Annual Table 3: WBG New Renewables Commitments (US $ millions) by Institution or Unit

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
GEF	—	—	3	26	30	10	7	39	6	56	66	9	36	6	14	47	48	121	90	15	629
GEF-IFC/TF	—	—	—	—	—	—	30	30	—	14	—	—	—	10	1	1	—	—	4	—	90
IBRD Carbon Finance	—	—	—	—	—	—	—	—	—	—	—	2	4	10	10	8	19	68	62	21	205
IBRD/IDA	53	2	20	201	270	19	8	132	10	128	127	9	128	165	114	128	253	70	117	804	2,757
IFC	—	—	33	—	—	—	—	135	—	15	—	6	1	15	—	51	9	154	72	587	1,077
IFC Carbon Finance	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	13	7	39	—	69
MIGA	—	—	—	—	—	30	2	—	—	26	252	—	—	—	—	—	2	—	88	—	401
Total Commitment	53	2	56	227	300	59	47	336	15	239	444	26	169	206	138	246	344	421	473	1,427	5,227

Annual Table 4: WBG Energy Efficiency Commitments (US $ millions) by Institution or Unit

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
GEF	—	—	—	10	26	25	3	39	22	1	45	5	1	49	33	53	4	7	55	68	444
GEF-IFC/TF	—	—	—	—	—	—	7	3	—	16	5	—	19	18	—	—	—	—	—	—	66
IBRD Carbon Finance	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	6	18	10	40	8	86
IBRD/IDA	—	265	54	—	33	123	350	14	328	9	244	188	35	34	56	3	433	49	621	1,311	4,152
IFC	—	—	—	—	—	—	—	—	6	—	1	—	12	75	—	155	306	156	473	315	1,497
MIGA	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	40	—	—	40
Special Financing	—	—	—	—	—	—	20	—	—	—	—	—	—	—	—	—	—	—	3	—	23
Total Commitment	—	265	54	10	59	148	380	56	356	26	295	193	67	177	92	217	761	262	1,192	1,701	6,307

Annual Table 5: WBG Hydropower (> 10 MW) Commitments (US $ millions) by Institution or Unit

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
IBRD Carbon Finance	—	—	—	—	—	—	—	—	—	—	—	—	4	—	8	25	3	66	24	—	129
IBRD/IDA	—	125	122	912	—	310	750	—	196	—	320	—	177	—	76	374	70	430	601	43	4,505
IFC	—	25	39	26	186	7	36	—	200	—	—	—	—	23	—	49	177	140	361	135	1,403
MIGA	—	—	—	—	—	—	33	15	65	—	—	—	—	—	—	91	—	115	21	—	339
Total Commitment	—	150	161	938	186	317	819	15	461	0	320	0	181	23	83	538	250	751	1,007	177	6,376

Annual Table 6: WBG Renewable Energy and Energy Efficiency Commitments (US $ millions) by Region

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
AFR	—	127	73	203	—	3	12	30	201	7	124	—	78	104	40	96	196	735	447	522	2,995
EAP	51	—	121	410	310	367	400	145	123	139	513	8	124	28	61	459	231	143	782	769	5,183
ECA	—	290	—	—	33	140	381	14	238	15	68	186	75	155	155	235	642	117	543	1,182	4,468
LCR	2	—	75	340	199	10	2	41	186	79	219	6	30	51	34	127	229	133	283	290	2,338
MNA	—	—	—	—	2	4	—	—	—	—	—	—	—	—	0	10	12	121	67	67	283
OTH	—	—	—	—	—	—	32	148	—	25	—	12	1	10	—	—	—	—	—	—	228
SAR	—	—	2	222	—	—	419	29	85	—	135	7	108	58	22	75	46	183	550	475	2,416
Grand Total	53	417	271	1,174	545	524	1,245	407	832	264	1,059	219	416	406	313	1,001	1,355	1,433	2,672	3,305	17,911

Annual Table 7: WBG New Renewables Commitments (US $ millions) by Region

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
AFR	—	2	18	3	—	3	8	30	5	6	124	—	16	104	33	41	27	20	252	103	794
EAP	51	—	—	—	300	49	—	112	2	139	—	3	18	—	56	127	144	93	23	567	1,685
ECA	—	—	—	—	—	—	7	—	9	6	6	2	—	3	44	10	9	12		515	624
LCR	2		37	2	—	3	2	20	—	78	204	6	26	31	5	53	135	100	77	137	918
MNA	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	1	5	65	56	11	142
OTH	—	—	—	—	—	—	30	145	—	10	—	12	1	10	—	—	—	—	—	—	209
SAR	—	—	2	222	—	—	—	29	—	—	110	2	108	58	—	13	24	131	65	94	856
Grand Total	53	2	56	227	300	59	47	336	15	239	444	26	169	206	138	246	344	421	473	1,427	5,227

Annual Table 8: WBG Energy Efficiency Commitments (US $ millions) by Region

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
AFR	—	—	—	—	—	—	4	—	1	1	—	—	—	—	6	3	10	79	41	418	564
EAP	—	—	54	10	10	8	—	33	121	—	193	5	1	28	5	75	65	24	654	57	1,341
ECA	—	265	—	—	33	140	374	14	229	9	62	183	65	144	51	54	632	97	341	663	3,357
LCR	—	—	—	—	14	—	—	6	—	1	15	—	0	5	22	63	36	24	123	151	459
MNA	—	—	—	—	2	—	—	—	—	—	—	—	—	—	0	9	6	16	11	57	101
OTH	—	—	—	—	—	—	2	3	—	15	—	—	—	—	—	—	—	—	—	—	19
SAR	—	—	—	—	—	—	—	—	6	—	25	5	1	—	7	13	11	21	21	355	466
Grand Total	—	265	54	10	59	148	380	56	356	26	295	193	67	177	92	217	761	262	1,192	1,701	6,307

Annual Table 9: WBG Hydropower (> 10 MW) Commitments (US $ millions) by Region

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Grand Total
AFR	—	125	55	200	—	—	—	—	196	—	—	—	62	—	—	51	159	636	153	—	1,637
EAP	—	—	67	400	—	310	400	—	—	—	320	—	105	—	—	257	22	26	105	145	2,156
ECA	—	25	—	—	—	—	—	—	—	—	—	—	10	8	61	170	—	7	202	5	487
LCR	—	—	39	338	186	7	—	15	186	—	—	—	4	15	8	11	58	10	83	2	961
MNA	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	40	—	—	40
SAR	—	—	—	—	—	—	419	—	79	—	—	—	—	—	15	49	11	32	464	26	1,095
Grand Total	—	150	161	938	186	317	819	15	461	0	320	0	181	23	83	538	250	751	1,007	177	6,376

Annex 3: Fiscal 2009 Projects

No.	Country	Project Name	Energy Type	Financing Sources	RE or EE Component Financing (USD millions)
		Africa Region			
1	Benin	GEF Energy Efficiency Program	EE	GEF	1.82
2	Benin	Increased Access to Energy Project	EE Biomass	IDA	48.91 13.55
3	Central African Republic	Emergency Power Response Project	EE	IDA	8.00
4	Côte d'Ivoire	Urgent Electricity Sector Rehabilitation Project	EE	IDA	44.00
5	Gambia	Coco Ocean	New Renewable Energy	IFC	0.20
6	Ghana	Ashesi University	New Renewable Energy	IFC	0.05
7	Kenya	Kenya Agriculture Productivity & Agribusiness Project	Small Hydro, Biomass, Wind, Solar	IDA	2.00
8	Mali	Mali Energy Support Project	EE	IDA	112.00
9	Mali	HEURA Additional Financing Project	EE Hydro, Solar, Wind	IDA	2.30 30.30
10	Nigeria	Electricity and Gas Improvement Project	EE	IDA	182.00
11	Senegal	Rural Lighting Efficiency Project	EE	Carbon Finance	1.80
12	Tanzania	Green Resources	New Renewable Energy	IFC	7.71
13	Togo	Emergency Infrastructure Rehabilitation & Energy Project	EE	IDA	3.00
14	Togo	Togo Efficient Lighting Program	EE	GEF	1.82
15	Uganda	Energy for Rural Transformation APL2	Solar	IDA GEF	40.40 9.00
16	Uganda	Umeme Limited	EE	IFC	12.78
		East Asia & Pacific Region			
17	China	Asia Environment Partners	New Renewable Energy	IFC	25.00
18	China	China Environment Fund III	EE	IFC	10.50
19	China	China Environment Fund III	New Renewable Energy	IFC	4.50
20	China	Thermal Power Efficiency Project	EE	GEF	7.68
21	China	Eco-Farming Project	Biogas	IBRD	103.41
22	China	Jiangxi Shihutang Navigation & Hydropower Project	Hydro > 10MW	IBRD	40.00
23	China	Suntech	New Renewable Energy	IFC	50.00
24	China	Xinao Solar	New Renewable Energy	IFC	60.00
25	China	Yaohua Glass	EE	IFC	25.34
26	China	Zhongda Hydro II	Hydro > 10MW	IFC	4.90
27	Indonesia	P.T. South Pacific Viscose	EE	IFC	13.70
28	Philippines	Ambuklao – Binga Hydropower Project	Hydro > 10MW	IFC	100.00
29	Philippines	Energy Development Corporation	New Renewable Energy	IFC	83.50
30	Philippines	Additional Financing for RPP Project	Solar	IBRD	20.00

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31	Thailand	Small Scale Livestock Waste Management Project	Biogas	Carbon Finance	6.39
32	Thailand	Bioenergy Sugar Ethanol Wastewater Management Project	Biomass	Carbon Finance	15.00
33	Vietnam	Renewable Energy Development Project	Small Hydro, Wind, Biomass	IDA	199.20
		Europe & Central Asia Region			
34	Belarus	Energy Efficiency Project	EE	IBRD	125.00
35	Bulgaria	AES Kavarna	New Renewable Energy	IFC	51.80
36	Croatia	CMC Sisak	EE	IFC	12.98
37	Kyrgyz Republic	Emergency Energy Assistance Project	EE	IDA	9.70
38	Lithuania	Renewable Energy Mezzanine Facility	New Renewable Energy	IFC	13.40
39	Macedonia, FYR	Municipal Development Project	EE	IBRD	5.00
40	Moldova	Energy II Additional Financing Project	EE	IDA	10.00
41	Moldova	SIF 2 Additional Financing Project	EE	IDA	0.75
42	Montenegro	Energy Efficiency project	EE	IBRD	9.40
43	Russian Federation	Kronostar III	New Renewable Energy	IFC	3.70
44	Russian Federation	Kuaz Energy Efficiency	EE	IFC	20.00
45	Russian Federation	MDM Bank	EE	IFC	35.00
46	Russian Federation	Nitol Solar	New Renewable Energy	IFC	50.00
47	Tajikistan	InfraVentures – Lake Sarez Hydropower Project	Hydro > 10MW	IFC	2.00
48	Tajikistan	PAMIR Additional Financing Project	Hydro > 10MW	IDA	2.50
49	Turkey	Ynna Asment	EE	IFC	4.68
50	Turkey	Private Sector RE and EE Project	EE	IBRD	200.00
51	Turkey	Private Sector RE and EE Project	Small Hydro, Wind, Geothermal, Biomass, Solar	IBRD	300.00
52	Turkey	Programmatic Electricity Sector DPL Project	EE	IBRD	200.00
53	Turkey	Rotor Elektrik Uretim A.S.	New Renewable Energy	IFC	71.51
54	Turkey	Trakya Cam VI	EE New Renewable Energy	IFC	30.02 24.67
		Latin America & Caribbean Region			
55	Argentina	Aceitera General Deheza S.A.	New Renewable Energy	IFC	2.05
56	Argentina	PERMER Renewable Energy Additional Financing Project	Solar, Wind	IBRD	50.00
57	Brazil	Bauducco NE	EE	IFC	0.59
58	Brazil	Estre Ambiental	New Renewable Energy	IFC	10.24
59	Chile	Norvind S.A.	New Renewable Energy	IFC	30.75
60	Colombia	Avianca	EE	IFC	50.00
61	Colombia	Cartones America, S.A.	EE	IFC	0.80
62	Colombia	Century Caruquia	New Renewable Energy	IFC	7.65
63	Colombia	Century Guanaqui	New Renewable Energy	IFC	7.85
64	Colombia	Riopalia	New Renewable Energy	IFC	14.76

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65	Guatemala	Bioethnol	New Renewable Energy	IFC	5.88
66	Guatemala	Panteleon S.A. II	New Renewable Energy	IFC	2.21
67	Honduras	Dinanat, S.A.	New Renewable Energy	IFC	2.40
68	Honduras	Power Sector Efficiency Enhancement Project	EE	IDA	8.90
69	LCR Region	*Sustainable Transport and Air Quality Project	EE	GEF	0.15
70	Mexico	**MX Sustainable Rural Development Project	EE	IBRD GEF	46.58 4.79
71	Mexico	Hipotecaria Vertice, S.A.	EE	IFC	25.00
72	Nicaragua	InfraVentures – El Salto Project	Hydro > 10MW	IFC	2.00
73	Nicaragua	Monte Rosa	New Renewable Energy	IFC	3.27
74	Paraguay	UABL, Ltd.	EE	IFC	13.98
		Middle East and North Africa Region			
75	Jordan	Energy Efficiency Project	Wind	GEF	6.00
76	Morocco	Ynna Asment	EE	IFC	1.78
77	Tunisia	Energy Efficiency and Renewable Investment Project	EE	IBRD	55.00
78	Yemen, Rep.	Rural Energy Access Project	Solar	IDA	4.65
		South Asia Region			
79	Afghanistan	NSP II Additional Financing Project	New Renewable Energy	IDA	11.25
80	India	Allain Duhangan II	Hydro > 10MW	IFC	25.94
81	India	**Chiller Efficiency Project	EE	Carbon Finance GEF	5.85 6.30
82	India	Coal-Fired Generation Rehabilitation Project	EE	GEF IBRD	45.40 180.00
83	India	Dishman Pharmaceuticals and Chemicals Ltd.	EE	IFC	0.29
84	India	Granules India Limited	EE	IFC	1.00
85	India	Hikal Limited	EE New Renewable Energy	IFC	0.30 1.43
86	India	Himadri Chemicals & Industries Limited	EE	IFC	3.63
87	India	Jain II	New Renewable Energy	IFC	16.40
88	India	Jain Irrigation	New Renewable Energy	IFC	8.43
89	India	JK Paper Ltd.	EE	IFC	3.00
90	India	Lanco Infratech	New Renewable Energy	IFC	12.79
91	India	Modern Dairy	EE New Renewable Energy	IFC	0.91 1.09
92	Maldives	Addu Investments Private Limited	EE	IFC	1.46
93	Nepal	Buddha Air	EE	IFC	10.00
94	Nepal	Nepal Power Additional Financing Project	EE Small Hydro	IDA	60.12 29.09
95	Pakistan	Engro Energy Pvt. Ltd.	EE	IFC	2.79
96	Pakistan	Global Trade & Finance Program – Pakistan	EE	IFC	34.00
97	Sri Lanka	Padgo Risk Share	New Renewable Energy	IFC	13.51

* This project financed activities in more than one country in the Latin America and Caribbean region.
** These projects received funding from multiple sources and are internally reported with multiple project identification numbers. However, they are reported as a single entry above.

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